Table Motion Troubleshooting

This chapter describes how to troubleshoot problems associated with UroView table motion. It is organized as follows:

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Table Movement Components

Components that create most Table movements are described and depicted below. Refer to the appropriate table motion discussion to find information on individual motors.

Table Generator Interface

The Table Generator Interface (TGI) is a GE OEC-designed PCB that interfaces GE OEC controls, indicators, and other devices to the Table manufacturer's Table Motion PCB (also known as the Motron board). The TGI performs the following functions that relate to Table movement:

- Interfaces with the ARCNet LAN to decode Table movement commands generated at the Collimator Control Panel.
- Decodes Manchester-encoded Table movement commands generated by the Table Hand Control.
- Converts all decoded Table movement commands to Table manufacturer's proprietary interface, and communicates with Table Motion PCB using this interface.
- Decodes fiberoptic Table position and other information from the Table Motion PCB, and places this information on the ARCNet for display on the Collimator Control Panel VFD and X-ray Control Console VFD, and for use by the OEC Workstation.

The TGI is located inside the Tower's backpack under an RFI-resistant cover. It is shown next.

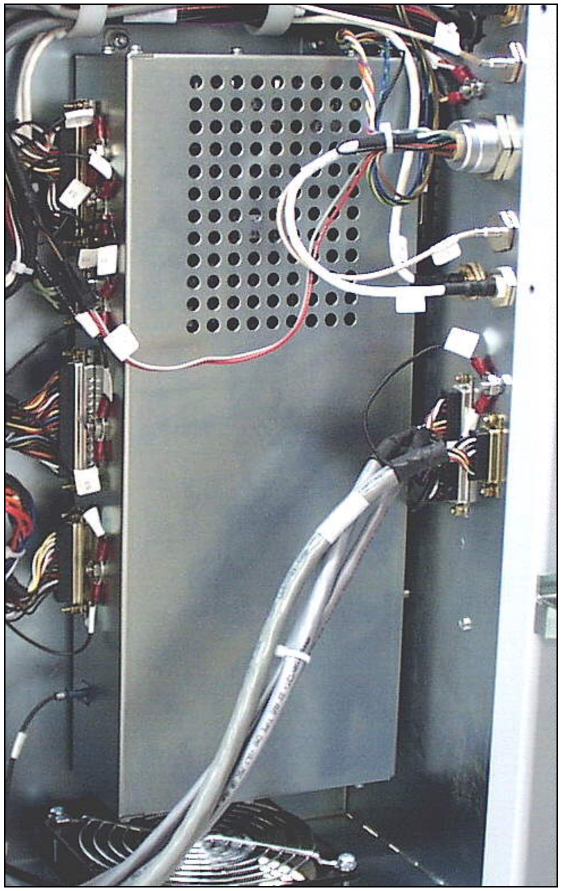


Table Generator Interface

Table Motion (Motron) PCB

The Table Motion PCB is provided by the Table manufacturer. Commonly called the Motron CPU board, it controls all powered Table movement by performing the following tasks:

- Communicates directly with the Table Footswitch using Table manufacturer's proprietary interface.
- Communicates with GE OEC Table motion controls through the GE OEC Table Generator Interface PCB.
- Generates drive signals for motor M6, which is responsible for Table lateral movement toward or away from the tower.
- Supplies serial RS-485 control signals to the Frequency Inverters, which generate the three-phase power necessary to run motors M1 through M5.
- Supplies enable signals to the Relay PCB, which provides power or braking current to M1, M2, M3, and M5, and power only to motor M4, which requires no brake.

The Table Motion PCB is also located inside the Tower. It is shown next.

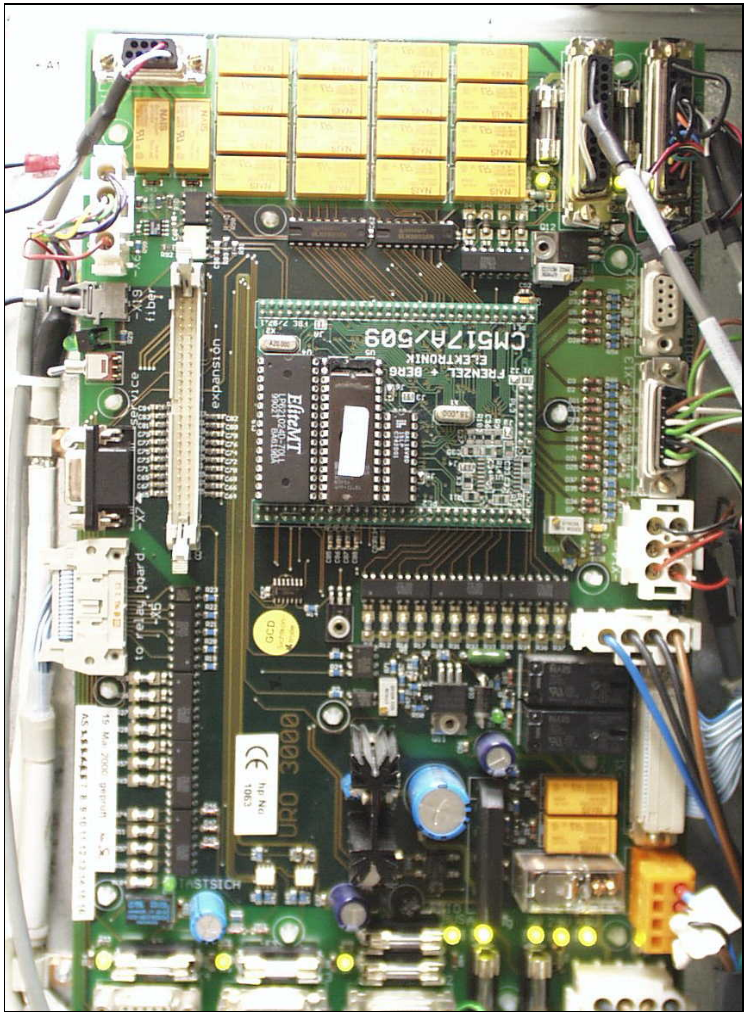
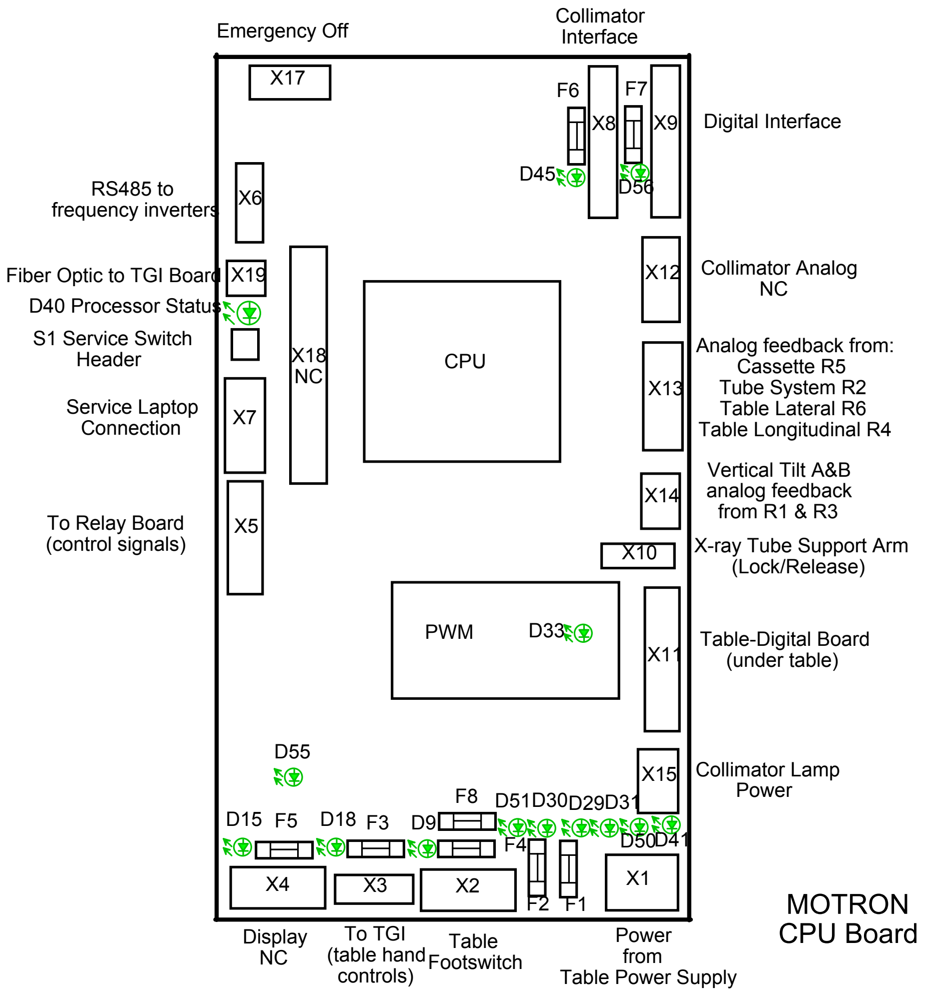

CM517A/509
FRENZEL + BERG
ELEKTRONIK
expansion
EliteMT
TASTSICH

Table Motion PCB

The following illustration shows important details related to the Table Motion (Motron) PCB:


Emergency Off
Collimator Interface
X17
F6
X8
F7
X9
Digital Interface
D45
D56
RS485 to frequency inverters
X6
Fiber Optic to TGI Board
X19
D40 Processor Status
S1 Service Switch Header
X18 NC
CPU
X12
Collimator Analog NC
X13
Analog feedback from: Cassette R5 Tube System R2 Table Lateral R6 Table Longitudinal R4
Service Laptop Connection
X7
X14
Vertical Tilt A&B analog feedback from R1 & R3
To Relay Board (control signals)
X5
X10
X-ray Tube Support Arm (Lock/Release)
PWM
D33
X11
Table-Digital Board (under table)
D55
X15
Collimator Lamp Power
F8
D51
D30
D29
D31
D15
F5
D18
F3
D9
F4
D50
D41
X4
X3
X2
F2
F1
X1
Display NC
To TGI (table hand controls)
Table Footswitch
Power from Table Power Supply

MOTRON
CPU Board

D9	8VAC to footswitch
D15	8VAC to display (NC)
D18	8VAC to TGI(Table Generator Interface
D29	VCC
D30	Output of bridge G3 (AVCC)
D31	+24V
D33	M6 Lateral
D40	Processor Status
D41	20VAC
D45	+24V
D50	+45V
D51	V+
D55	Tast_24V (from Emergency Off circuit)
D56	+24V

F1	(3.15AT) Input to bridge G1 & G2 (8VAC
F2	(0.5AT) Input to bridge G3 (8VAC)
F3	8VAC(315mAT) to TGI
F4	8VAC(100mAT) to footswitch
F5	8VAC(315mAT) to display (NC)
F6	+24V(1AT)
F7	+24V(1AT)
F8	V+(100mAT)(referenced to V-) output of

Table Motion (Motron) PCB Details

PCB Versions

There are two versions of the Motron CPU PCB currently in use, both with the same part number (00-901941-01). This document discusses the older board, which is characterized by the outboard "Y Adapter" PCB. This board has been used on all Uroview systems until recently (December, 2002).

A newer version of the PCB has become available and will appear in all new Tables. The new version of the Motron CPU board is a plug-compatible, direct replacement for the old Motron CPU PCB. Some of the major differences between the two boards are more surface-mounted components, test pads, one less fuse, a programmable logic device (CPLD) to replace several TTL registers, and a service switch with a remote service switch connection. This new version of the board has the ’Y’ adapter function built into the board. The old ‘Y’ adapter board will not be needed when doing a field service replacement with a newer board.

A large majority of the components on the new board are surface mounted. The optoisolators are now packaged as individual chips instead of in sets of two or four as with though-hole components on the older boards. See the chip table below to compare optopisolators between the old and new boards, or check optoisolator function.

Click on the Schematics button below to get piece part details on each of the boards. The Schematics section provides a detailed assembly drawing and schematic for each board.

Test Pads

Test pads have been added to the new Motron CPU PCB. These will be useful when needing a ground reference to make a measurement else were on the board. The test pads are listed in pairs in the table below with the voltage supply in the left column and the ground reference in the right middle column. The VCC RELA power supply is controlled by transistor Q1 and microprocessor whose output becomes ENABLE to power the output relay coils. Please refer to page 5 of the New Motron CPU Schematic to see these details.

Test Pad Details

Test Pad Name	Test Pad	Ground Ref.	Test Pad
AVCC	1	AGND	2
VCC	3	GND	4
+8V	5	M8	6
+24V	7	M24	8
+45V	9	M45	10
VCC RELA	11	GND	12

Fuses

The fuses on the new board are the same with the exception of the fuse F2 that has been dropped and is now incorporated into the fuse F1. The fuse value of the F4 fuse has changed from 0.1 amps to 0.3 amps to match the other external control connectors.

Fuse Comparison Between Old and New Motron CPU PCBs

Old Fuse	Old Size	New Fuse	New Size	Function
F1	3A	F1	1.5A	VCC Power
F2	0.5A	F1	1.5A	AVCC
--	--	F1	1.5A	Output Relay Power
F3	0.3A	F3	0.3A	X3 Hand Control
F4	0.1A	F4	0.3A	X2 Foot Control
F5	0.3A	F5	0.3A	X4 Display
F6	1A	F6	1A	Collimator Leaf Power
F7	1A	F7	1A	+24V X9 TGI
F8	0.2A	F8	0.2A	Key Safety Lines Relay

New PLD

TTL registers IC3, IC4, IC5, IC6, and IC7 are now incorporated into CPLD chip IC2. The outputs of this chip are buffered with transistor drivers on IC3, IC4, and IC5 of the new board to drive the output relays.

New Service Switch and Remote Service Connector

A service mode switch and remote service mode connector X16 are on the new Motron CPU board. When the remote service switch is plugged into the 3-pin X16 connector (Molex type) the board's service switch needs to be in the service mode position (Up) for the remote switch to work properly. When the board service switch is in the RUN position (Down) then the remote service mode switch will be disabled and the Motron CPU board will be in the RUN mode. Refer to sheet 14 of the New Motron CPU PCB schematic to see these details.

Acronyms and Signal Names

Some of the signal nomenclature has been changed from German to English with better acronyms on the schematics.

Old-to-New Acronym Comparison

Old Acronym	New Acronym	Meaning
NOTAUS	XMERG	Emergency Off
TAST_24V	XKEY_S	Key Security line
TB_LIGHT	C_LIGHT	Collimator Light
BV_2	MAG_1	Mag Mode 1
BV_1	MAG_2	Mag Mode 2
O_DURCHL	FLUR_AC	Fluoro Mode Acknowledge
O_AUFN	FILM_AC	Film Mode Acknowledge
I_DURCH+	FLURO+	Fluoro Mode Request
I_AUFN+	FILM+	Film Mode Request
I_DURCH-	FLURO-	This pin is grounded to X9 - 13

Old Acronym	New Acronym	Meaning
I_AUFN-	FILM-	This pin is grounded to X9 - 24
ZUBH	ACESS_OK	Accessory OK
CRASH_BV	CRASH_II	Splash and Crash on II
POS_KASS	POS_CASS	Film Cassette Position
CRASH_TA	CRASH_AS	X-ray arm crash – not used
POS_TRAG	POS_ASSE	X-ray arm position
RESET_NO	RESET_N	Latch relay K1 on the Table Digital Board

Output Relays

The output relays on the new Motron CPU PCB function the same as those on the old boards. However the relay positions and reference designators have changed. Refer to the assembly drawings for each board in the schematics section of this CD for layout details.

Output Relay Locations

Old Relay	New Relay	Function
K8	K20	Emergency Stop
K24	K24	Emergency Stop Acknowledge
K22	K8	Fluoro Mode Acknowledge
K21	K19	Collimator Lamp Power

Old Relay	New Relay	Function
K20	K21	M6 Direction
K19	K22	M6 Enable
K18	K18	Latch relay K1 on Table Digital Board
K16	K16	Film Mode Acknowledge
K11	K12	MAG1
K10	K11	MAG2

LEDS and Associated Fuses

The following table compares the LEDS on the old Motron CPU PCB with those on the new PCB.

LEDs and Associated Fuses

Fuse Association	Old LED	New LED	Function
F3	D18	LED1	Power Hand Control (TGI)
F4	D9	LED2	Power Foot Control
F5	D15	LED3	Pausch Display (not used)
--	D50	LED4	+45V
--	D31	LED5	+24V
F8	D51	LED6	+8VAC Key Safety Line
F1	D29	LED7	VCC

Fuse Association	Old LED	New LED	Function
--	D41	LED8	20VAC
--	D40	LED9	Service Mode / CPU status
F1 new F2 old	D30	LED10	AVCC
--	D55	LED11	Security Key Closure
F7	D56	LED12	+24V to TGI
F6	D45	LED13	+24V to Drive Collimator Leaves
--	--	LED14	RS 485 Bus Power
F1	--	LED15	VCC_RELA (output relay power)
--	D33	LED16	M6 Lateral Motor Enabled

IC Comparison

The following table compares integrated circuits on the old Motron CPU PCB with ICs on the new PCB.

Comparison of ICs on Old and New Motron CPU PCB

Old IC	New IC	Function
IC10	IC6	Bucky
IC10	IC7	Miktion
IC10	IC8	Leg Ext
IC10	IC9	Acess OK

Old IC	New IC	Function
IC16	IC10	K 18x43
IC16	IC11	K 24x30
IC16	IC12	K 25x43
IC16	IC13	K 30x24
IC17	IC56	Pos Cass
IC17	IC14	Crash II
IC18	IC16	Reserve
IC11	IC17	M1
IC11	IC18	M2
IC11	IC19	M3
IC11	IC20	M4
IC21	IC21	M5
IC13	IC22	K M1
IC13	IC23	K M2
IC13	IC24	K M3
IC13	IC25	K M4
IC20	IC26	K M5
IC20	IC27	FU1_N>0
IC20	IC28	FU2_N>0
IC9	IC33	RI_QUER
IC9	IC40	M6

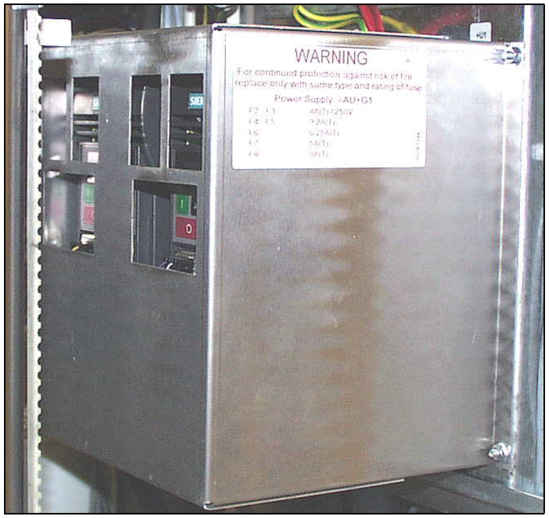
Old IC	New IC	Function
IC22	IC41	PWM_QUER
IC18	IC59	Film Request
IC18	IC60	Fluoro Request
IC3	IC2	Input Reg. Motor Relays
IC4	IC2	Input Reg. Cassette
IC5	IC2	Output Latch Motors
IC6	IC2	Output Latch Collimator
IC7	IC2	Output Latch Mode
--	IC3	Transistor Drivers Output Relays
--	IC4	Transistor Drivers Output Relays
--	IC5	Transistor Drivers Output Relays

Frequency Inverters

The two Frequency Inverters in the Uroview Table Subsystem perform similar tasks. Each converts single-phase AC power from the Table Power Supply to variable frequency, variable duty cycle, three-phase AC to run motors M1 through M5. Varying the duty cycle controls the starting and running torque of each motor. Varying the frequency controls motor speed. Each Frequency Inverter has the following additional features:

- Controlled by a serial RS-485 signal from the Table Motion (Motron) PCB.
- Provides switching for 24 VDC power that, when applied, releases brakes on Motors M1-M3 and M5. M4 has no built-in brake.

The Frequency Inverters are located in the Tower as shown in the following illustration. Frequency Inverter U1 powers Motor M1 or M2, and Frequency Inverter U2 powers M3, M4, or M5. The Relay PCB switches power to the selected motor(s). Only one motor runs at a time, except when M1 and M3 run together to raise, lower, or tilt the table.



Two Frequency Inverters Under a Single EMI Shield

The following table summarizes the functions of the two Frequency Inverters

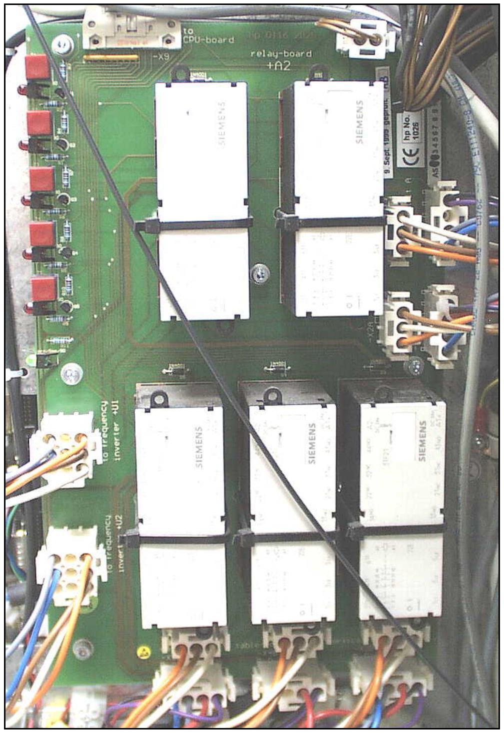
Note. Each frequency inverter can power only one motor at a time. Vertical or tilt motion requires power from both U1 and U2.

Frequency Inverter Assignments

Frequency Inverter U1	Frequency U2
Motor M1 - Vertical/Tilt A	Motor M3 - Vertical/Tilt B
Motor M2 - Image Chain	Motor M4 - Table Longitudinal
	Motor M5 - Film Cassette Movement

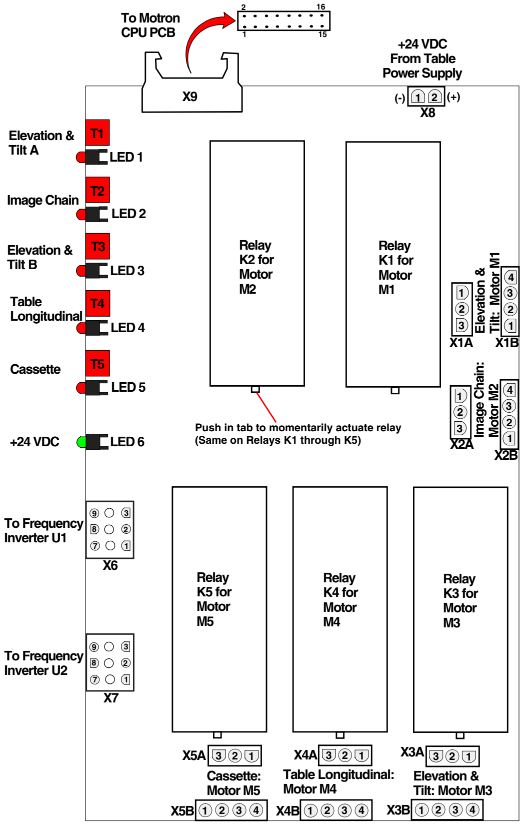
Relay PCB

The Relay PCB uses Relays K1 through K5 to apply three-phase power from the Frequency Inverters to the individual Table motors. K1 controls M1, K2 controls M2, etc. The Relay PCB also applies +24 Volts to release motor brakes on motors M1 - M3 and M5. The Table Motion CPU (Motron) PCB controls the Relay PCB with enable signals to its individual relays. The Relay PCB is located in the Tower. It is shown in the following illustration.



Relay PCB

The following picture provides additional Relay PCB details:


To Motron CPU PCB
2
16
1
15
X9
+24 VDC From Table Power Supply
(-) ① ② (+)
X8
Elevation & Tilt A
T1
LED 1
Image Chain
T2
LED 2
Elevation & Tilt B
T3
LED 3
Table Longitudinal
T4
LED 4
Cassette
T5
LED 5
+24 VDC
LED 6
Relay K2 for Motor M2
Relay K1 for Motor M1
Elevation & Tilt: Motor M1
X1A
X1B
Image Chain: Motor M2
X2A
X2B
Push in tab to momentarily actuate relay (Same on Relays K1 through K5)
To Frequency Inverter U1
X6
To Frequency Inverter U2
X7
Relay K5 for Motor M5
Relay K4 for Motor M4
Relay K3 for Motor M3
X5A ③ ② ①
Cassette: Motor M5
X4A ③ ② ①
Table Longitudinal: Motor M4
X3A ③ ② ①
Elevation & Tilt: Motor M3
X5B ① ② ③ ④
X4B ① ② ③ ④
X3B ① ② ③ ④

K1/T1 - Elevation and Tilt - Motor M1
K2/T2 - Image Chain - Motor M2
K3/T3 - Elevation and Tilt - Motor M3
K4/T4 - Table Longitudinal - Motor M4
K5/T5 - Film Cassette - Motor M5

Relay PCB Details

Table Digital PCB

The Table Digital PCB is primarily a passive component that serves as a junction point for signals associated with Table movement. It is quite small and is located underneath the covers on the bottom of the Table. The small relay on the Table Digital PCB is not used in the Uroview 2800. The following illustration shows the Table Digital PCB mounted to the underside of the Table.

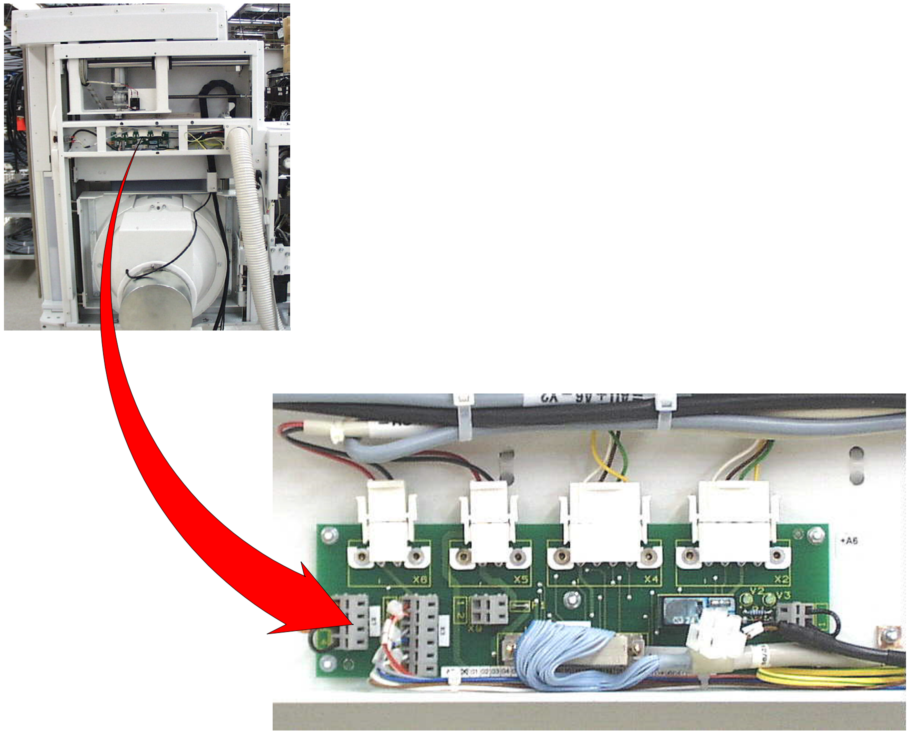


Table Digital PCB

The following illustration is an assembly drawing of the Table Digital PCB that identifies individual connectors and components.

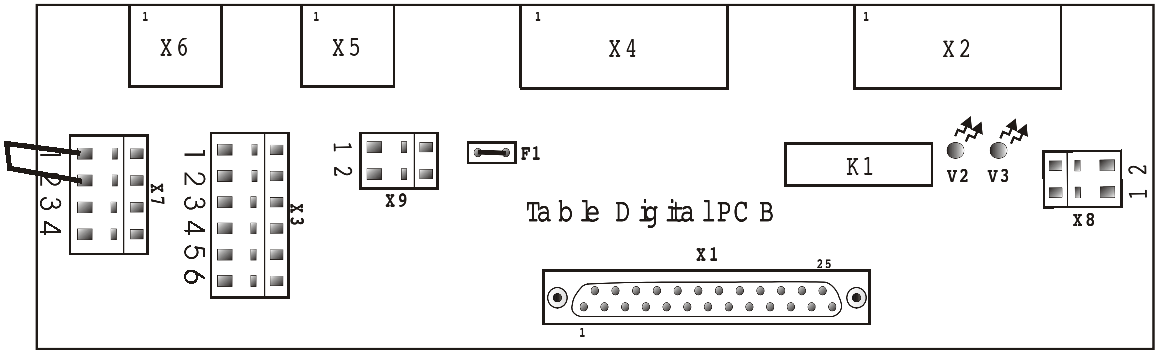

1
X6
1
X5
1
X4
1
X2
1 2 3 4
X7
1 2 3 4 5 6
X3
1 2
X9
F1
K1
V2
V3
2 1
X8
Table Digital PCB
X1
25
1

Table Digital PCB Assembly Drawing

Table Power Supply

The Table Power Supply consists of the items shown within the dotted line on Table Power Supply schematic 885025. Major components include a circuit breaker, power transformer, bridge rectifiers, filter capacitors, line filters, and fuses.

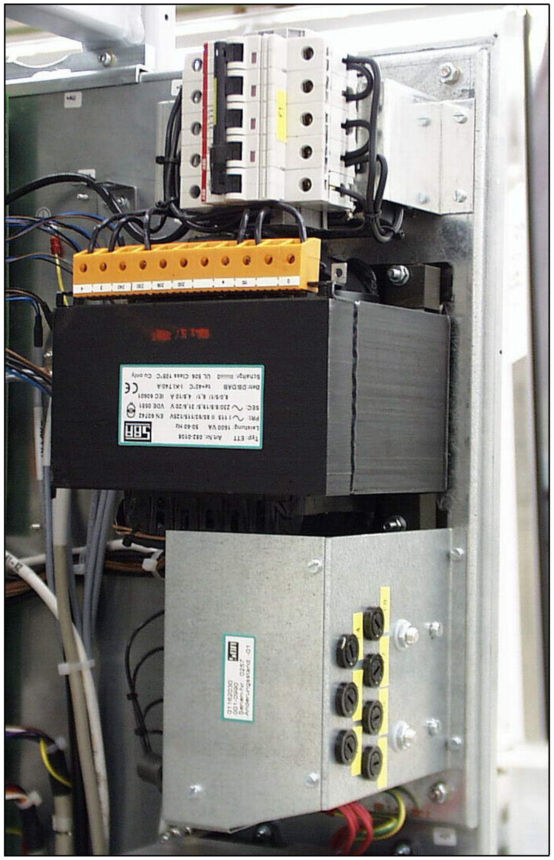


Table Power Supply

Table Key Controls

Use the Table Hand Control, Table Footswitch, or Collimator Control Panel to control table movement. Only one version of the Footswitch is shown. Refer to the Table Key Controls section of this chapter for additional technical details and troubleshooting information on these devices.

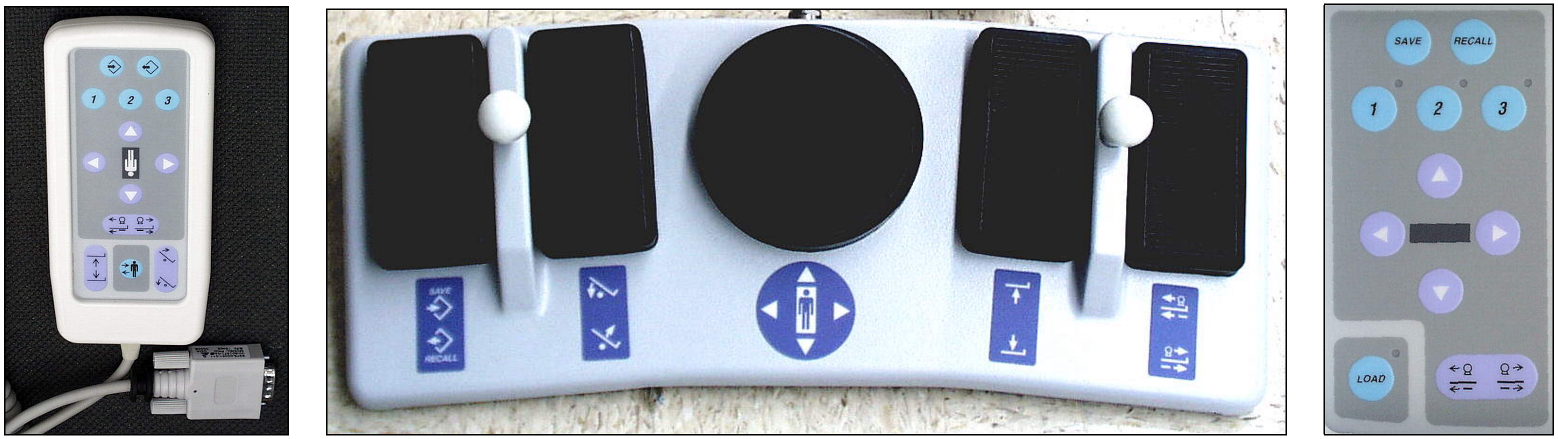


Table Key Controls

Table Movement Error Messages

The following is a list of table movement information and error messages. The list includes messages than can appear on the Vacuum Fluorescent displays and/or messages that the system places in the error log. This table alphabetizes information by the Displayed Message. If there is no displayed message, list alphabetization is by Logged Message. Click anywhere on the hyperlinked portion of the message line to go to the related troubleshooting procedure. Messages marked with an asterisk (*) are for information only and do not indicate a table motion failure. These information messages have no related troubleshooting procedures.

Error	Displayed Message	Logged Message	Code
Unknown table accessory not correctly installed	ACCESSORY INSTALLATION ERROR	TBL UNKNOWN ACCESSORY INSTALLATION ERROR	40
Table accessory not correctly installed	ACCESSORY INSTALLATION ERROR	TBL ACCESSORY INSTALLATION ERROR	41
Relay FU1 Frequency Problem - Motor Operating in Error	CALL SERVICE - 50 (Line 2 of VFD)	TBL FU1 FREQUENCY PROBLEM	50
Analog voltage failed	CALL SERVICE - 61 (Line 2 of VFD)	TBL ANALOG VOLTAGE FAILED	61
Relay FU0 Frequency Problem - Motor operating in error	CALL SERVICE - 67	TBL FL0 FREQUENCY PROBLEM	67

Error	Displayed Message	Logged Message	Code
Film door not closed during Film Request mode	*CASSETTE DOOR OPEN	None	32
Film Size Error	CASSETTE NOT READY	None	57, 58
Collision, Image Intensifier Cover	DOWN MOTION BLOCKED (Line 3 of VFD)	TBL II COVER COLLISION	42
Vertical Motion Stopped due to Calculated Motion Limit	DOWN MOTION LIMITED	None	86
X-ray Arm and Cassette not centered during Film mode request	FILM FAILURE - 36	TBL IMAGE CHAIN NOT CENTERED	36
X-ray Arm Assembly to Center Position Reached	*FILM MODE READY	None	None
Longitudinal motion stopped due to calculated motion limit	LONG MOTION LIMITED	None	85
Potentiometer Table Top Longitudinal M4 Status	*LONG = xx	None	None
Potential Vertical height status - pre-calculated (M1+M3)/2	*MAXIMUM HEIGHT	None	None
Potentiometer Tilt Status - pre-calculated (M1-M3)	*MAXIMUM TILT	None	None
Potential Vertical height status - pre-calculated (M1+M3)/2	*MINIMUM HEIGHT	None	None
Potentiometer Tilt Status - pre-calculated (M1-M3)	*MINIMUM TILT	None	None

Error	Displayed Message	Logged Message	Code
Motor M6 Problem - Table Lateral	MOTION FAILURE - 51	TBL LATERAL MOTOR PROBLEM	51
Motor M5 Problem - Cassette/Film Transport	MOTION FAILURE - 52	TBLE FILM TRANSPORT MOTOR PROBLEM	52
Motor M4 Problem - Table Longitudinal	MOTION FAILURE - 53	TBL LONG MOTOR PROBLEM	53
Motor M3 Problem - Vertical/Tilt B	MOTION FAILURE - 54	TBL TILT MOTOR PROBLEM	54
Motor M2 Problem - X-ray Arm Assembly	MOTION FAILURE - 55	TBL IMAGE CHAIN MOTOR PROBLEM	55
Motor M1 Problem - Vertical/Tilt A	MOTION FAILURE - 56	TBL ELEVATION MOTOR PROBLEM	56
Tilt/Elevation Motion Blocked/Potentiometer R1 Problem	MOTION FAILURE - 62	TBL TILT MOTION FAILURE - R1	62
Tilt/Elevation Motion Blocked/Potentiometer R3 Problem	MOTION FAILURE - 63	TBL ELEVATION FAILURE - R3	63
Lateral Motion Blocked/Potentiometer Problem	MOTION FAILURE - 64	TBL LATERAL MOTION FAILURE	64
Longitudinal Motion Blocked/Potentiometer Problem	MOTION FAILURE - 65	TBL LONG MOTION FAILURE	65
X-ray Arm Assembly Motion Blocked/ Potentiometer Problem	MOTION FAILURE - 66	TBL IMAGE CHAIN MOTION FAILURE	66

Error	Displayed Message	Logged Message	Code
Film Transport Motion Block/Potentiometer Problem	MOTION FAILURE - 70	TBL FILM TRANSPORT MOTION FAILURE	70
Limit Switch or gearbox overheating Problem M1 or M3	MOTION FAILURE - 71	TBL TIL/ELEVATION LIMIT OR OVERHEAT	71
Limit switch or gearbox overheating problem M2	MOTION FAILURE - 72	TBL IMAGE CHAIN LIMIT OR OVERHEAT	72+
Limit switch or gearbox overheating problem M4	MOTION FAILURE - 73	TBL LONG LIMIT OR OVERHEAT	73
Frequency Inverter U1 for tilt/vertical, image chain out of order	MOTION FAILURE - 101	TBL FREQ CONVERT 0 ERROR	101
Frequency Inverter U2 for tilt/vertical, longitudinal, cassette out of order	MOTION FAILURE - 102	TBL FREQ CONVERT 1 ERROR	102
Remove cassette	*REMOVE CASSETTE	None	87
Analog voltage failed	TABLE COMMUNICATIONS FAILED (Line 1 of VFD)	TBL ANALOG VOLTAGE FAILED	61
Potentiometer Table Top Longitudinal M4 Status	*TABLE LONG AT LIMIT	None	None
Release of Film Exposure Contact Closure prior to X-ray Assembly and Cassette reaching Film Exposure Position during Film Mode Request.	None	TBL FILM MODE RELEASE EARLY	44
Potentiometer X-ray Tube Arm M2 Status-	*X-RAY ARM = xx	None	None

Error	Displayed Message	Logged Message	Code
Potentiometer X-ray Tube Arm M2 Status	*X-RAY ARM AT LIMIT	None	None
Potentiometer X-ray Tube Arm M2 Status	*X-RAY ARM CENTERED	None	None
X-ray Assembly Arm not in X-ray Ready during X-ray Mode request	X-RAY ARM NOT READY (Line 1 of VFD)	X-RAY ARM NOT READY	33
Collision, Image Intensifier Cover	X-RAY BLOCKED (Line 2 of VFD)	TBL II COVER COLLISION	42
X-ray Assembly Arm not in X-ray Ready during X-ray Mode request	X-RAY BLOCKED (Line 2 of VFD)	X-RAY ARM BLOCKED	82

Table Top Lateral Movement (M6)

The following block diagram shows the circuitry that moves the Table top toward or away from the Tower. For additional details not depicted in this diagram, please refer to the schematics section of this CD.

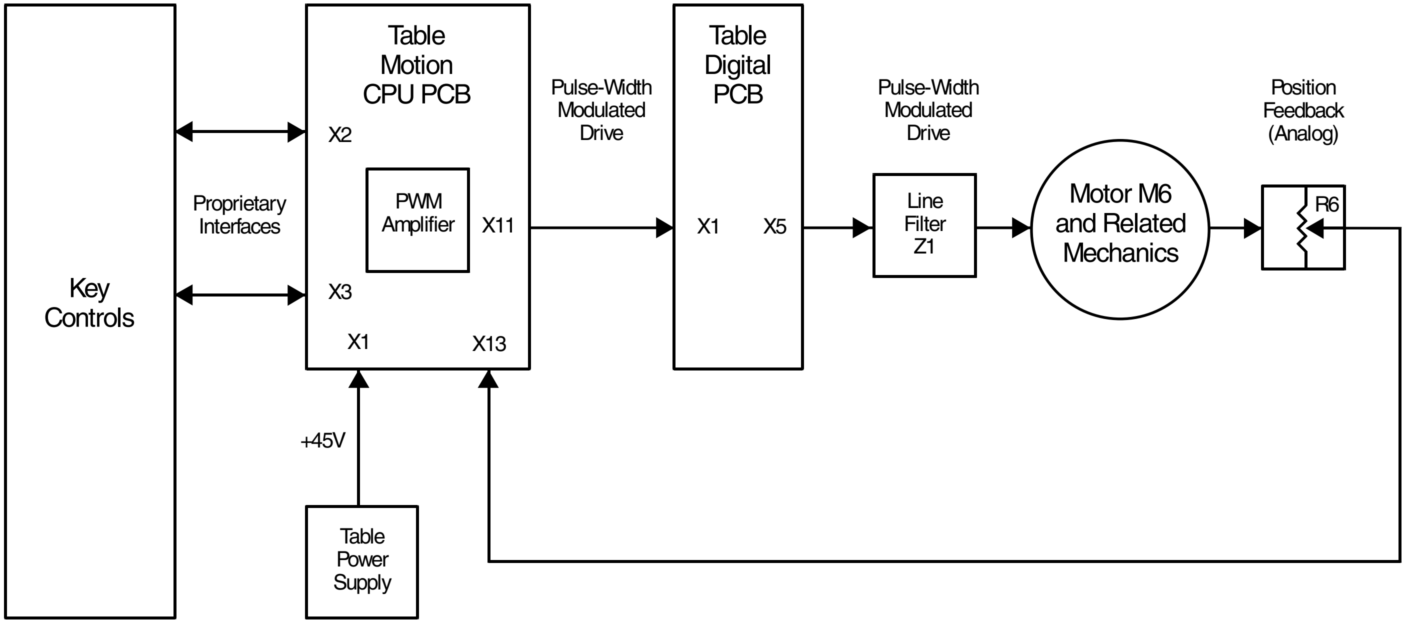

Key Controls
Proprietary Interfaces
Table Motion CPU PCB
X2
PWM Amplifier
X11
X3
X1
X13
+45V
Table Power Supply
Pulse-Width Modulated Drive
Table Digital PCB
X1
X5
Pulse-Width Modulated Drive
Line Filter Z1
Motor M6 and Related Mechanics
Position Feedback (Analog)
R6

Table Top Lateral Movement Circuitry

Motor M6

Motor M6 under the head end of the table performs tabletop lateral movement. M6 is the only DC motor in the table. (M1 through M5 are AC synchronous motors.) Lateral movement is the only Uroview 2800 table motion that doesn't use the

Frequency Inverters or Relay PCB. Lateral table movement requires several components, including the Table Power Supply, Table Motion CPU PCB, Table Digital board, Line Filter, motor M6, Potentiometer R6, and the associated cabling and Key Controls.

Table Power Supply

Motor M6 receives its power from the unregulated +45 VDC section of the Table Power Supply. The ground for this output is isolated from the other power supply grounds. In fact, there are six separate grounds associated with outputs from this supply. This section of the supply is protected by fuse F7 (5A), which mounts with the other Table Power Supply fuses on a panel located directly below power transformer T1.

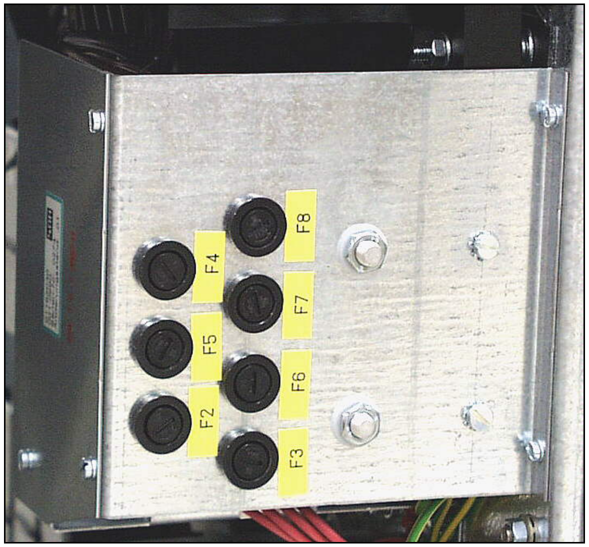
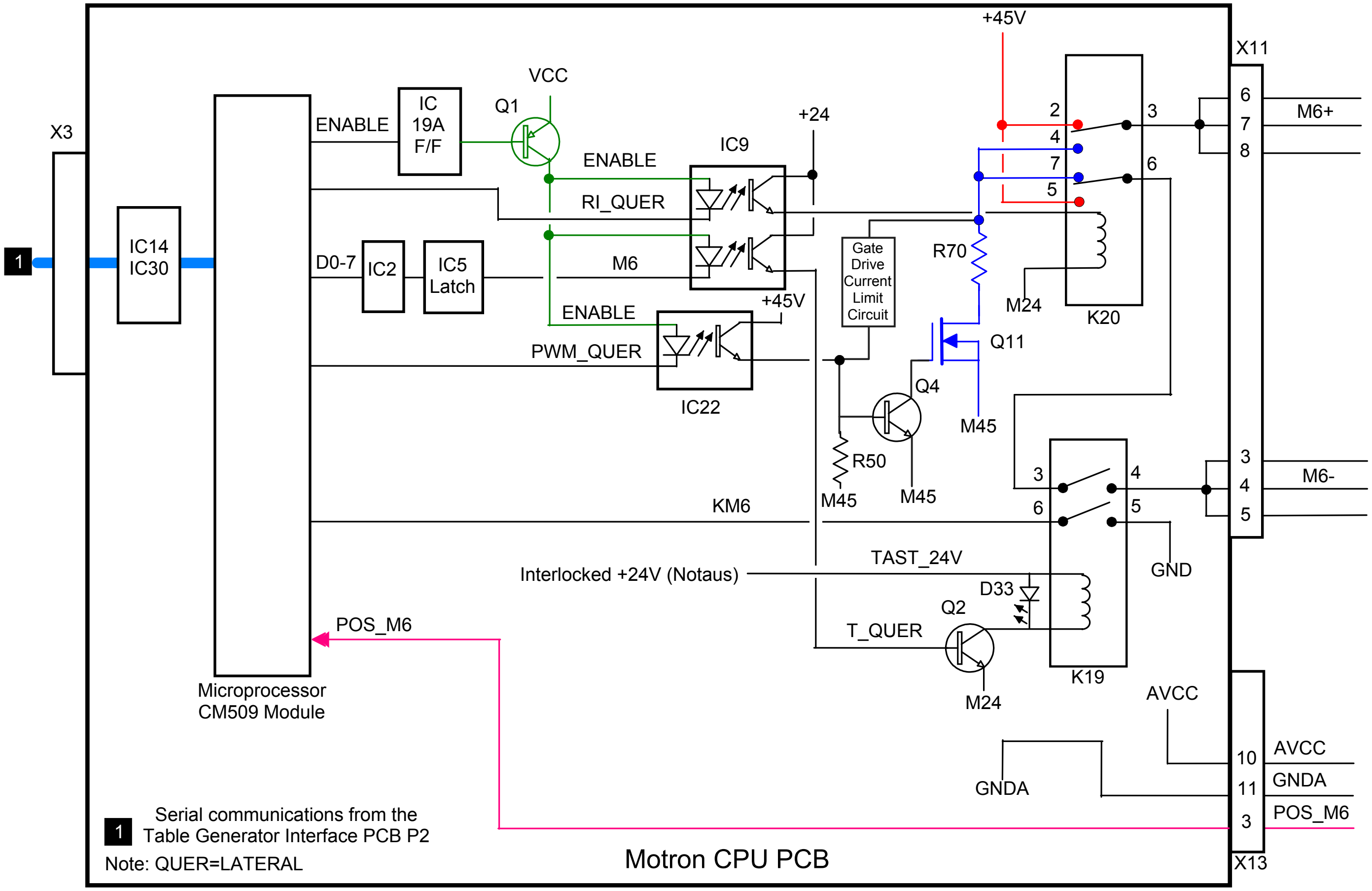


Table Power Supply Fuses

Motor M6 Speed and Direction Control

The following illustration shows M6's speed and direction control circuitry on the Table Motion CPU (Motron) PCB.


+45V
X11
VCC
X3
Q1
IC
19A
F/F
ENABLE
ENABLE
IC9
+24
2
4
7
5
3
6
6
7
8
M6+
RI_QUER
1
IC14
IC30
D0-7
IC2
IC5
Latch
M6
Gate
Drive
Current
Limit
Circuit
R70
M24
K20
ENABLE
+45V
PWM_QUER
IC22
Q11
Q4
M45
R50
M45
M45
KM6
3
6
4
5
3
4
5
M6-
GND
TAST_24V
Interlocked +24V (Notaus)
D33
Q2
T_QUER
POS_M6
Microprocessor
CM509 Module
M24
K19
AVCC
10
11
3
AVCC
GNDA
POS_M6
GNDA
X13
Motron CPU PCB

1 Serial communications from the Table Generator Interface PCB P2

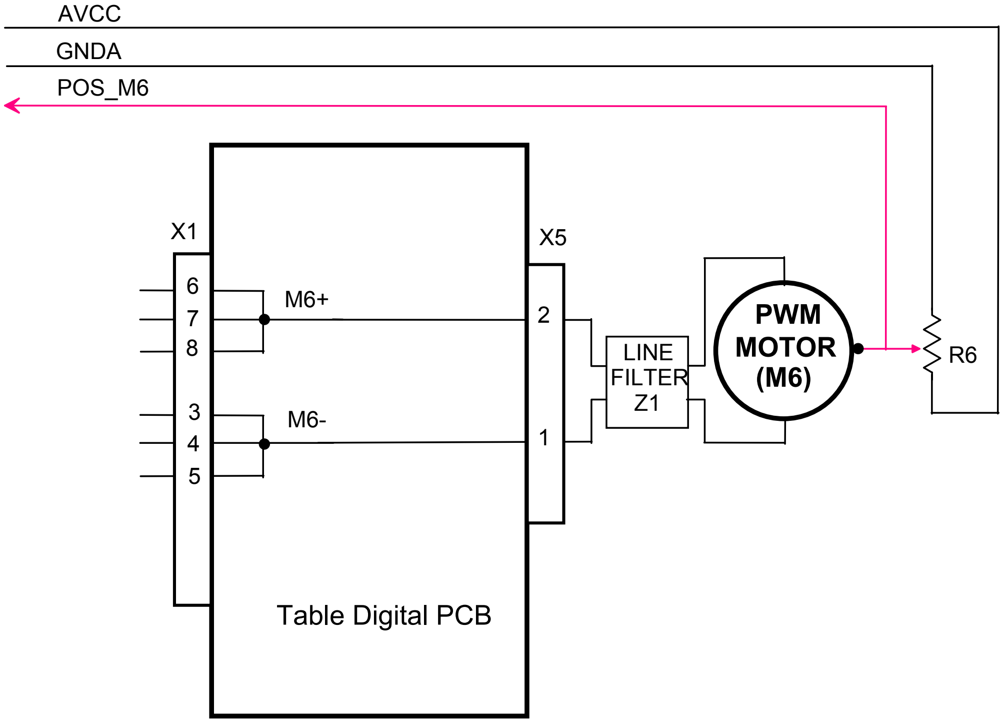
Note: QUER=LATERAL

M6 Speed and Direction Control Circuitry

The Table Motion CPU (Motron) PCB controls M6's speed by pulse width modulating the DC power to the motor. One output port of the CPU drives optoisolator IC22, which controls power FET (Q11). When the CPU turns the power FET on, the FET completes the circuit to ground. Relays K19 and K20 on the CPU board control gross motor movements. K20 controls motor direction (forward / reverse). K19 controls the motor on/off function. Relay K19 receives power from the emergency stop / security loop 24 VDC circuit. Emergency stop activation removes power from K19 and shuts down the motor.

Motor Power and Position Feedback Circuits

The following diagram shows how pulse-width modulated power gets to motor M6 from the Table Motion CPU (Motron) PCB, and how R6 detects the CPU table's lateral position.


AVCC
GNDA
POS_M6
X1
6
7
8
3
4
5
M6+
M6-
X5
2
1
LINE FILTER Z1
PWM MOTOR (M6)
R6
Table Digital PCB

Motor M6 Power and Position Feedback Circuits

A ribbon cable runs from connector X11 on the CPU board to X1 on the Table Digital PCB, which is under the table near the head end close to lateral motor M6. The Table Digital PCB has the connections for the emergency off switch and safety circuits. Power for the motor M6 is a straight run across the Table Digital PCB from the X1 connection of the ribbon cable to the X5 connector to line filter Z1. The output of the line filter Z1 goes directly to the lateral motor M6.

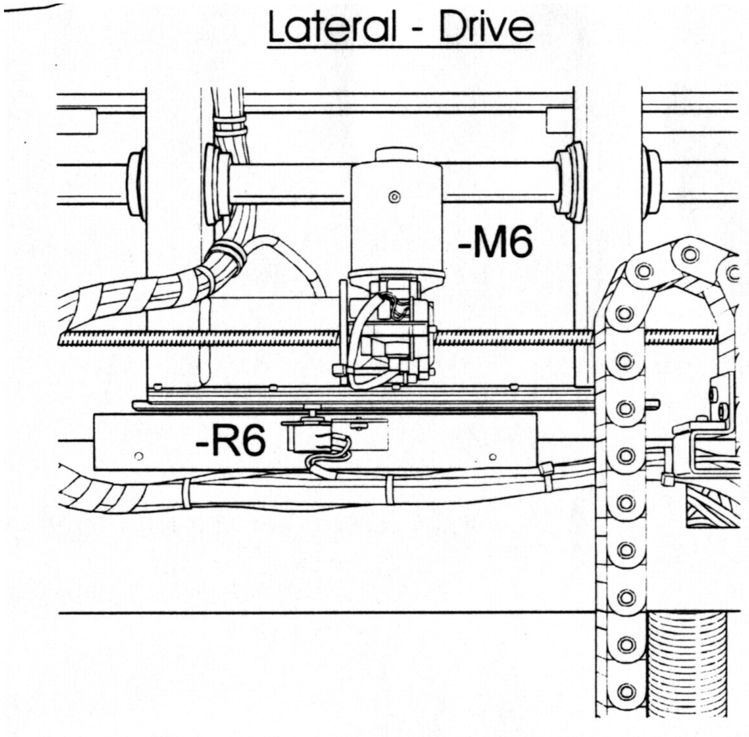
Potentiometer R6 provides the feedback control loop for lateral table movement. This pot has a gear on its shaft that tracks on a rack attached to the table. As the table moves, an analog-to-digital converter on the Motron CPU PCB reads the output of R6. The CPU compares the digital readout of the pot's position with the software limits held in the table calibration file (.hpp). When the readout matches the software limit, software turns the motor off.

Motor and Cable Protection

There are no limit switches for safety stops if the software calibration fails on the lateral motion. Instead, a current limit circuit to power FET (Q11) on the CPU board provides the motor and cable protection. This current limit is set at the factory by pot R53 on the CPU board to between 2 and 4 amps. NPN transistor Q4 on the CPU board shorts the power FET gate drive signal to ground, stopping M6. Resistor R70 and the power FET form the current sense for Q4. When the base of the transistor reaches 600 mV through the voltage divider created by R53, R11, and R50, the transistor turns on and shorts the gate drive to ground.

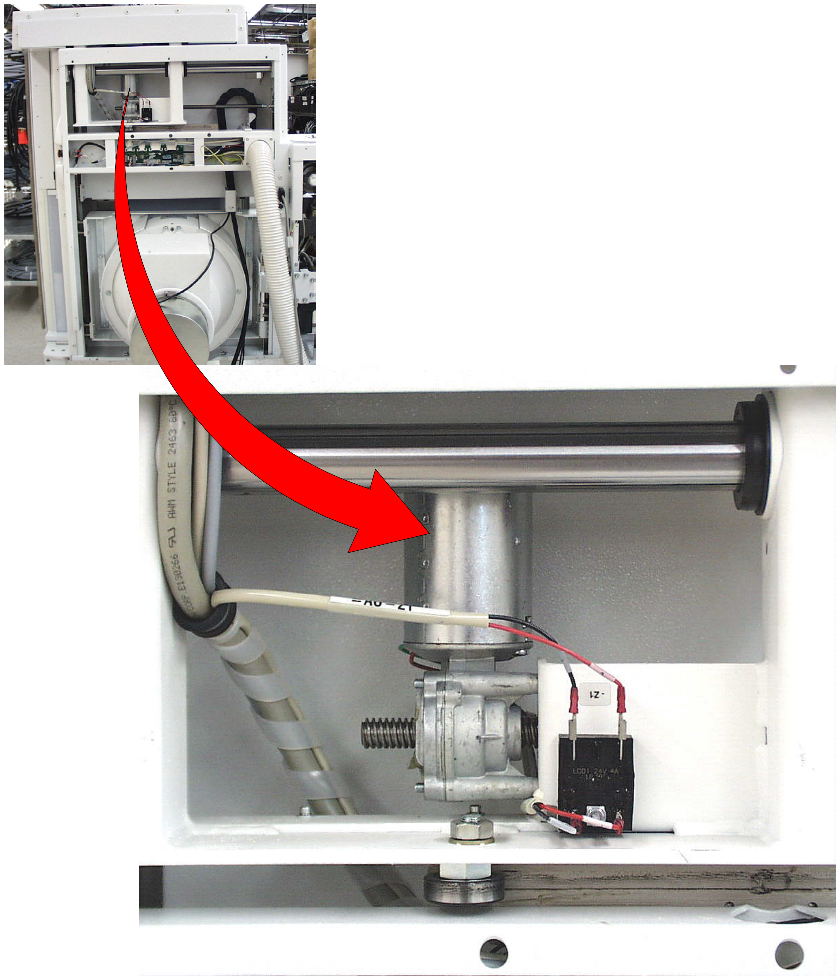
Physical Details

The following illustration shows lateral motion motor M6 and potentiometer R6 as they appear when viewed from above with the Table top removed.



Lateral Drive Components - Top View

Here is another view of the lateral drive components as seen from under the table. You can see M6 and line filter Z1 but not R6.



Lateral Drive Components - Bottom View

Error Messages

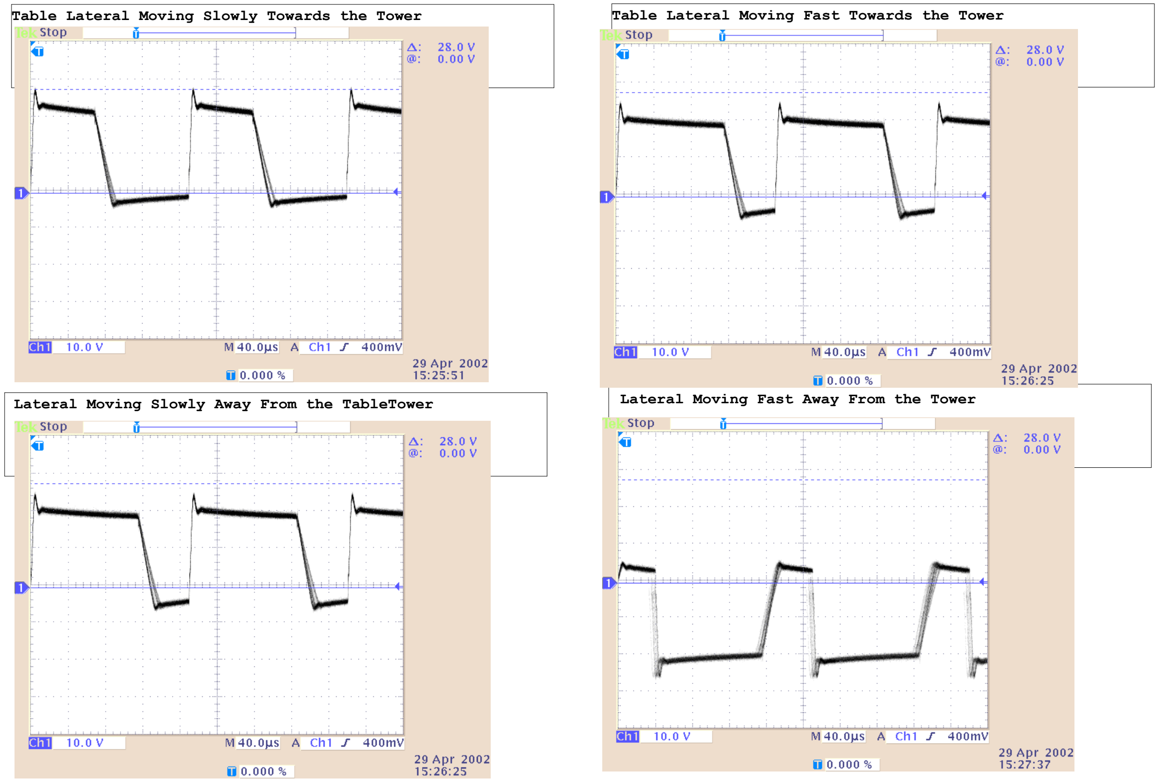
Lateral Table movement failures can generate the following error messages. Displayed messages appear on the UroView VFD and logged Table Messages appear in the recorded Error Log.

Lateral Movement Error Messages

Error	Displayed Message	Logged Message	Code
Motor M6 Problem – Table Lateral	MOTION FAILURE -51	TBL LATERAL MOTOR PROBLEM	51
Lateral Motion Blocked/Potentiometer Problem	MOTION FAILURE -64	TBL LATERAL MOTION FAILURE	64

Normal Waveforms

You can view the following waveforms on pin 2 of connector X5 on the Table Digital PCB. Use pin 1 of X5 as the reference.



Note: All signals are referenced to Pin One of X-5 on the Table Digital Board.
May also use voltmeter to measure - 21V for slow speed and 32 volts for fast.

Normal M6 Drive Waveforms

Troubleshooting

Use the following procedure when you have consistent lateral motion failure and there are no other symptoms.

M6 Problems

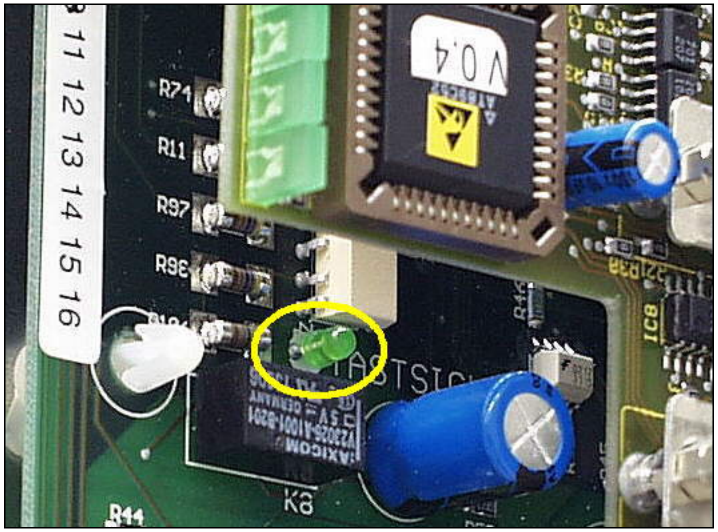
Question	Yes	No
1. Analog Voltage Error Code 61?	Analog Voltage Error 61	Step 2
2. Do All Controls Fail?	Step 3	Control Key Problem
3. Check Pot R6 and its Cabling. Is each OK?	Step 4	Replace Bad Pot or Cable
4. Check Power and Motor. Are each OK?	Step 5	Repair or Replace Bad Part
5. Check Motron CPU PCB for proper operation. Is it OK?	Call Technical Support	Replace Faulty Motron PCB

Control Key Problem

If you can't make the Table move laterally using the Footswitch, Handswitch, or Collimator Control Panel keys, the problem most likely is somewhere else besides the controls. (It is very unlikely that all lateral motion keys would fail at the same time.) Go to the next step in this procedure (Pot Problems).

If you can move the Table laterally using one but not all control keys, you have a control problem. Start troubleshooting the failing control by following this procedure:

1. Remove the covers necessary to gain access to the Motron board.
2. Turn on the system and let it boot completely.
3. Press the failing key while looking at LED D55 on the Motron board. This LED is under the Y-Distribution PCB as shown in the following picture. If the LED lights, go to step 4. If the LED does not light, there is a security problem with this control. Refer to the Key Controls section of this chapter for troubleshooting information.



LED D55 on Motron Board

4. Remove Top Cover from Table Tower.
5. Connect your laptop to the serial port on top of the Table Tower. Set the RUN/SERVICE switch to the SERVICE position.
6. Turn on the laptop and allow it to boot completely.
7. Open the Utility Suite and select the Motron tool option.
8. Open the oec_new.hpp file and select the Read CPU button.
9. Select the Monitor button, which opens up a new window
10. Select Option 3, which enters the Control-Test window.
11. Press keys on the control unit you are having problems with. Verify that the Motron board sees each button press. Refer to the Key Controls section of this manual for more information on the number assigned to each key

Note: If each button press does not appear in the Control Test window, you probably have a bad control unit or a cable problem.

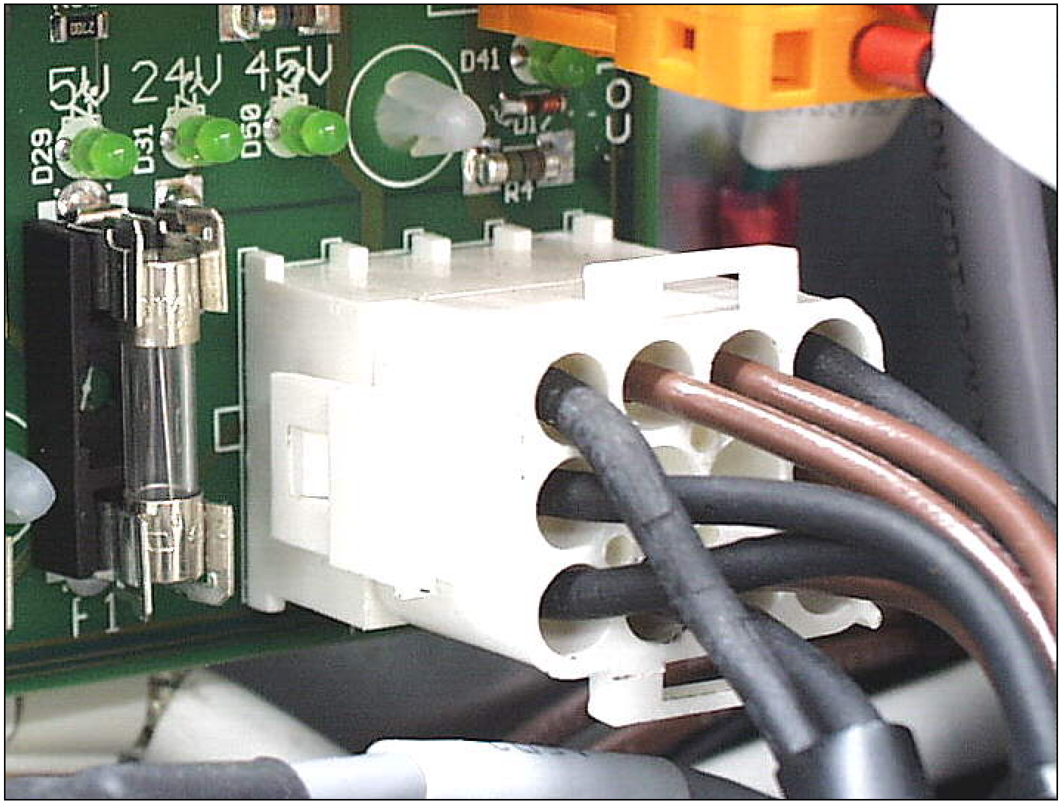
Note: Collimator control requests show up in the hand control columns.

Potentiometer Problem

1. Remove the Top Cover from the Table Tower
2. Turn on the system power and let the table boot fully.
3. Connect your laptop to the serial port, and set the RUN/SERVICE switch to the SERVICE position.
4. Open the Utility Suite software and select the Motron tool option.
5. Open the oec_new.hpp file and select the Read CPU button.
6. Click the Monitor button to open up a new window.
7. Select Option 2 to open the Analog Test window.
8. Check the M6 line in the window. If the value is between 25 and 1000, pot R6 is probably OK. Go to next step in this procedure (Power/Motor problems) to continue troubleshooting. If the value is not between 25 and 1000, table software does not allow lateral motion and generates an error message. Go to step 9.
9. Gain access to R6. (For a quick look, enter Film mode and open the Film Cassette door. You can see R6 through the door.)
10. Check the gear on the pot for cracks. You must replace the gear if it is cracked. If the gear is not cracked, go to step 11.
11. While looking at the Analog Test window, spin the pot gear and see if its value changes. If the value changes, move the pot to the center of its range, drive the table to the center position, re-center the pot, and calibrate this motion. If the value displayed in the Analog Test window does not change as you rotate the pot gear, go to step 12.
12. Remove the plug from connector X13 on the Motron board. R6 connects to pins 3, 10, and 11 of connector X13, with pin 3 being the wiper. The resistance between pins 10 and 11 should be 10K ohms. If this is not the case, troubleshoot the cabling and pot to find the bad component.

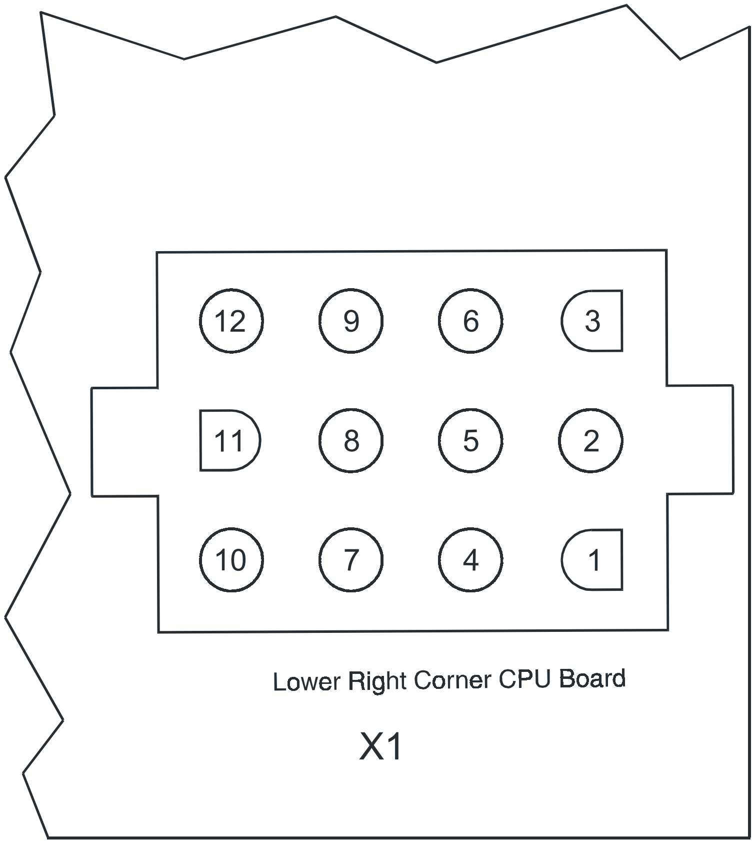
Power and Motor Problems

The following illustration shows LED D50, and connector X1, which are located in the bottom right-hand corner of the Table Motion (Motron) PCB. Locate these two items before reading the following discussion.



LED D50 and Connector X1 on Motron PCB

The following illustration shows complete details for connector X1:



Connector XI
Power Connection to
Motron CPU Board

Pin#	Description
1	+24VDC
2	20VAC_2
3	20VAC_1
4	24V_GND
5	NC
6	45VDC_GND
7	8VAC_2
8	NC
9	+45VDC
10	8VAC
11	8VAC
12	8VAC_1

Pin Pairs*		LED
1-4	+24VDC	D31
2-3	20VAC	D41
7-12	8VAC_2,1	D51, D30, D29
9-6	+45VDC	D50
10-11	8VAC	D30

*Grounds are not common between pin pairs.

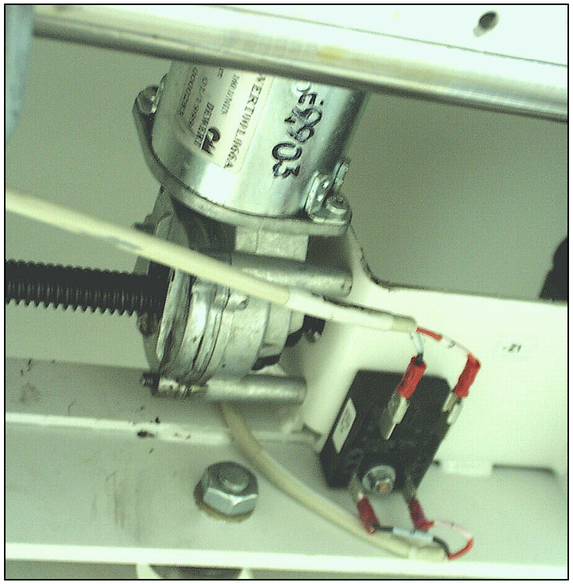
Connector X1 Pinouts

Use the following procedure to check power to motor M6 and the motor itself:

1. Make sure system is powered down completely.
2. Remove the covers necessary to access the Table Motion (Motron) PCB and Table Power Supply.

WARNING: Do not check F7 unless system is powered down completely. Dangerous electrical shock many otherwise result.

3. Check fuse F7, which is located on the fuse panel below Table Power Transmformer T1. It should be a 5A slow blow type. Use an ohmmeter to verify its continuity. Replace the fuse if it is bad; reinstall the fuse if it is OK.
4. Turn on the system and allow it to boot completely.
5. Check LED D50 on the Motron PCB. This LED should be on, indicating that the +45 VDC output on the Table Power Supply is good.
6. The 45-Volt unregulated DC power from the Table Power Supply gets to the Motron board via a cable plugged into connector X1 on the Motron PCB. Make sure that +44 volts is present between pins 9 and 6 (GND for the 45VDC supply). If +44 volts is present, proceed to the next step. If not, replace the transformer power module (P/N 00-901943-01)
7. Locate Motor M6 and Line Filter Z1 under the table as shown next.



Lateral Motor M6 and Line Filter Z1

8. Use a DVM set to DC volts to check for motor drive power to line filter Z1. When you first press a lateral button, the meter should indicate 10 to 20 VDC for a short period.

Note: The meter is not showing a steady DC value. Instead, it shows an averaged PWM drive signal from the Motron PCB to Motor M6. This signal has a period of about 150usec and a frequency of about 6.6 kHz.

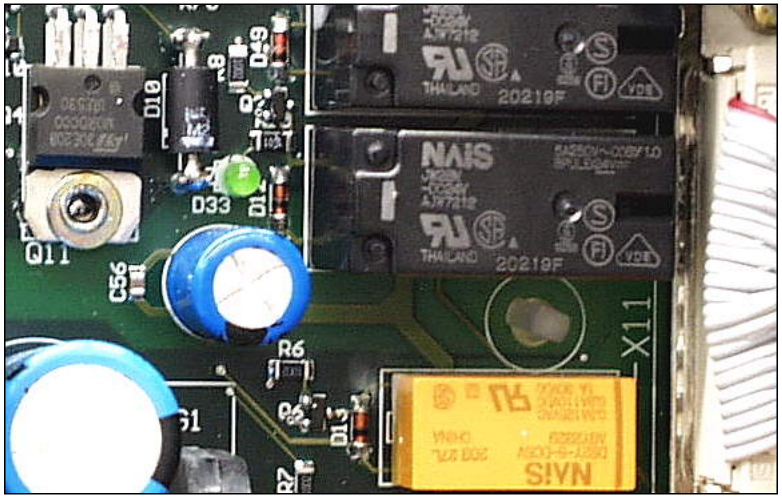
Note: PWM drive power for M6 leaves the Motron PCB on connector X11, enters the Table Digital PCB on X1, travels directly to X5 on the Table Digital PCB, and travels through Line Filter Z1 to the motor.

9. If voltage is not present in step 8, check the cabling from the Motron PCB to Motor M6. Six pins on the 25 pin D connector supply power to Motor M6. Pins 3, 4, and 5 are negative. Pins 6, 7, and 8 are positive. Remove the cable from the Motron CPU PCB at connector X11. Check the resistance from pins 3 to 6, 4 to 7, and 5 to 8 in pairs. Each loop should have a resistance of about 4 ohms through the line filter and motor. If the cable is open or its resistance is much greater than 4 ohms, reconnect X11 to the Motron CPU PCB and remove other end of ribbon cable at Table Digital PCB connector X1. Measure the resistance of cable conductor pairs 3 to 4, 3 to 5, 6 to 7 and 6 to 8. The resistance of each cable loop should be approximately 2.0 ohms. If the resistance of any loop is greater than 2 ohms or any loop is open, the ribbon cable between the Motron CPU PCB and the Table Digital PCB is bad. Repair or replace the cable.
10. Leave the cable disconnected from X1 on the Table Digital PCB, and disconnect the cable from X5 on the Table Digital board. This removes the Table Digital PCB completely from the circuit and allows you to check it for opens. Measure the resistance from X1 pins 3, 4 and 5 to X5 pin 1, and the resistance from X1 pins 6,7, and 8 to X5 pin 2. A high resistance on any path indicates a bad Table Digital board. Check for a poor solder joint, bad connector, broken trace or other simple problem before replacing the Table Digital PCB.
11. Check the resistance of the cable you disconnected from connector X5 on the Table Digital PCB. Check across pins 1 and 2 on the plug. You should see about 1.8 ohms. If you see an open circuit or a short, the cabling, line filter, or motor is bad.
12. Be sure to check the resistance of the motor itself before replacing it. You should see about 1.7 ohms directly across the motor's terminals. If you see a dead short or a high resistance, replace the motor.
13. If you haven't found a problem so far, check the screw and tabletop for free movement. Remove the two bolts from the lead screw and turn the screw to make sure it rotates freely and smoothly. Turn the screw so that the mount is near the motor. Make sure the table slides freely on its rails. Make corrections as needed. Bolt lead screw back to table mount.

CPU Board Problems

Follow these steps to find lateral motion troubles on the Table Motion (Motron) PCB:

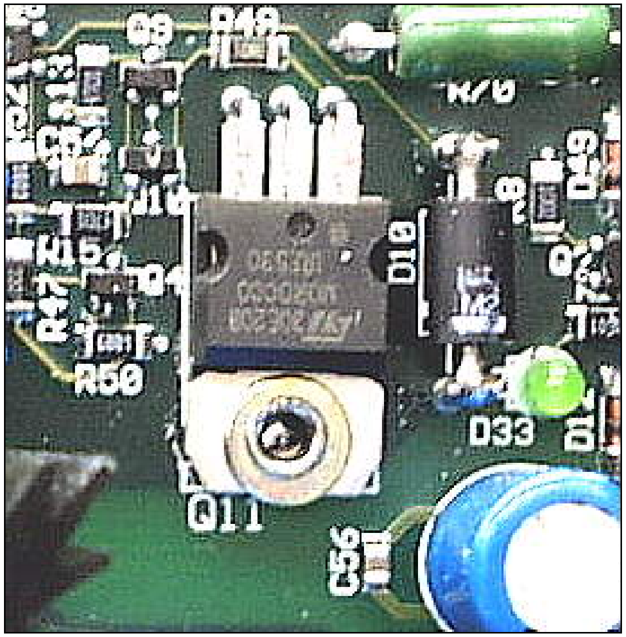
1. Remove cover to provide access to Table Motion (Motron) PCB. Extend PCB from chassis.
2. Turn on system and allow it to boot completely.
3. Press any lateral movement button and watch LED D33, which is a couple of inches to the left of connector X11, as shown in the following picture. The LED should light when you press the button, indicating that relay K19 on the Motron board is being energized to turn on Motor M6.



LED D33 on the Table Motion (Motron) PCB

Note: Use X1 pin 6 for ground when making the following measurements. X1 is the power connector in the lower right-hand corner of the PCB.

4. Locate Q4 and R50 on the Table Motion (Motron) PCB. These are surface mount components directly to the left of Q11 as shown in the following illustration.



Q4 and R50 on the Table Motion (Motron) PCB

5. Arm yourself with a magnifier, a well-calibrated DVM, and a small probe.

6. Check the base of NPN transistor Q4 on resistor R50 for a current limit fault while trying to move the Table laterally. 20 mVDC on the base is normal operation. 600 mVDC or greater means the motor is in current limit. Try to determine the cause of the current limit. Check for blocked mechanical motion, shorted cabling, a shorted motor, etc. If you can find no obvious cause, replace the Table Motion (Motron) CPU PCB.
7. Check FET (Q11) on gate pin 1. You should see the PWM drive signal from IC22. If no drive signal is present, replace the Table Motion (Motron) CPU PCB.

CAUTION: Follow the procedure in the Replacement section of the service manual to replace the Table Motion (Motron) PCB. Use care to avoid electrostatic discharge and be careful to preserve table calibration data.

Table Longitudinal Movement (M4)

The following paragraphs describe the circuitry that performs longitudinal (head-to-foot and foot-to-head) movement of the Table top. For additional details not shown in this diagram, please click the Schematics button at the bottom of this page.

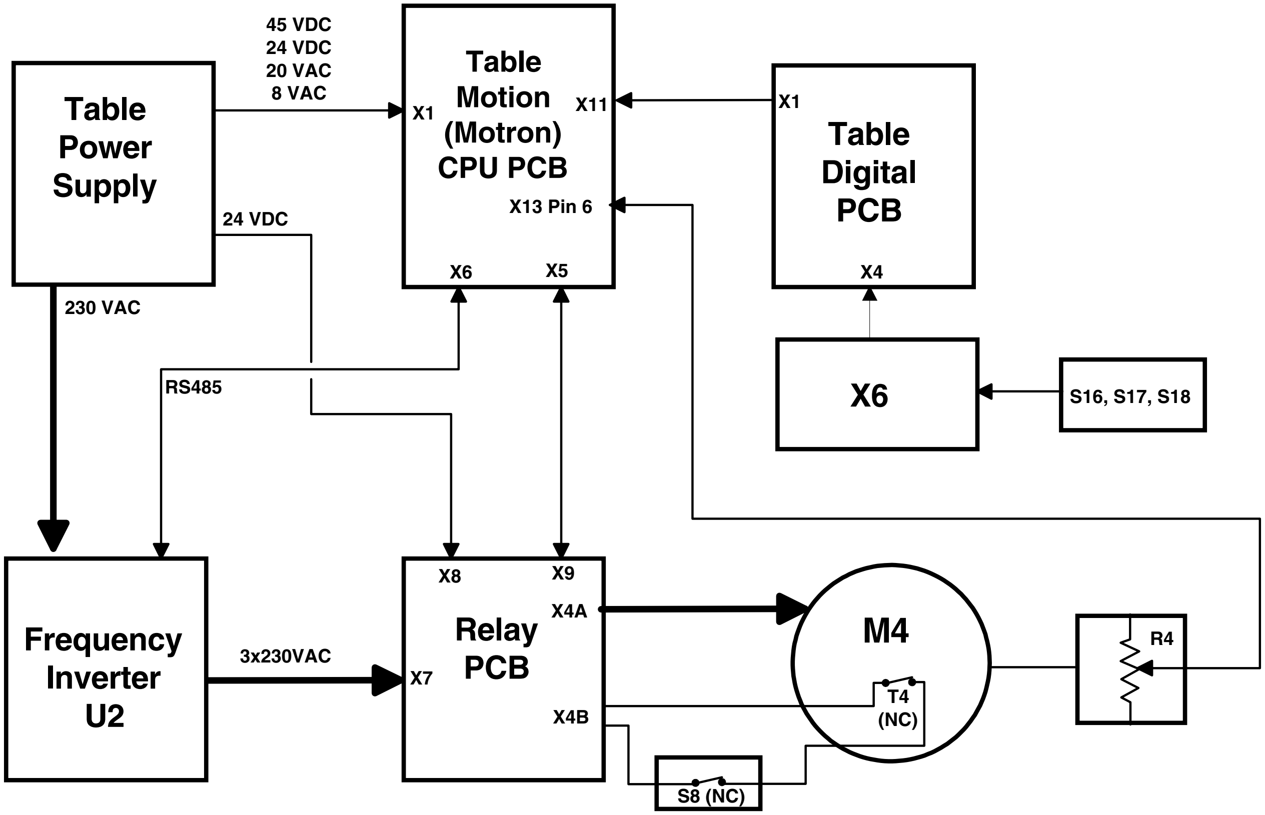
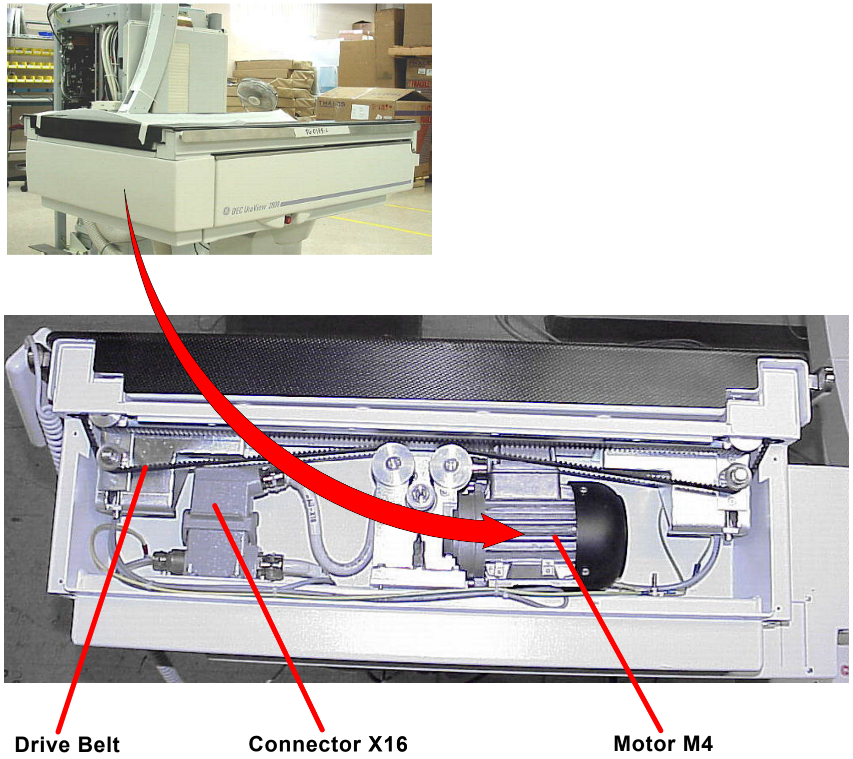

45 VDC
24 VDC
20 VAC
8 VAC
Table Power Supply
24 VDC
230 VAC
X1
Table Motion (Motron) CPU PCB
X11
X13 Pin 6
X6
X5
X1
Table Digital PCB
X4
X6
S16, S17, S18
RS485
Frequency Inverter U2
3x230VAC
X8
X9
X4A
X7
Relay PCB
X4B
M4
T4 (NC)
R4
S8 (NC)

Table Top Longitudinal Movement Circuitry

Overview

When you press a table longitudinal movement button on the Table Hand Control, Foot Control, or Collimator Control Panel, motor M4 moves the Table. M4 drives a belt that turns two screws, one on each side of the Table top. This movement drives a gear on multi-turn Potentiometer R4, which provides a voltage for the Motron CPU PCB to use to determine Table top longitudinal position. The following picture shows M4, the drive belt, and connector X16, which is the interconnecting point between M4 and the Relay PCB



Motor M4 and Associated Components

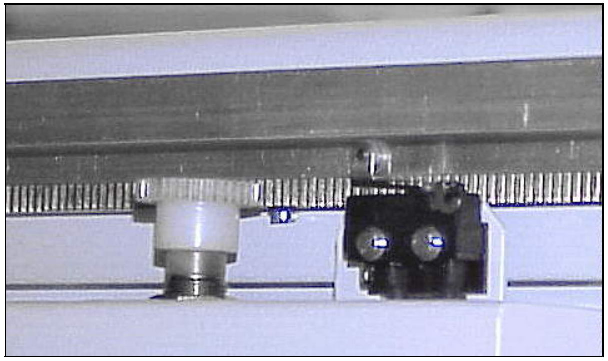
Communications

The Motron CPU PCB controls M4 by providing commands to and evaluating status information from Frequency Inverter U2 over an RS-485 serial link. The Motron CPU PCB retrieves control parameters for M4 from a stored parameter list. U2 receives single-phase 230 VAC power from the Table Power Supply, which it converts to three-phase 230 VAC for the Motor. The Motron CPU PCB varies the frequency and duty cycle of the three-phase power to control the torque, speed, and direction of M4.

Potentiometer R4 and Safety Switch S8

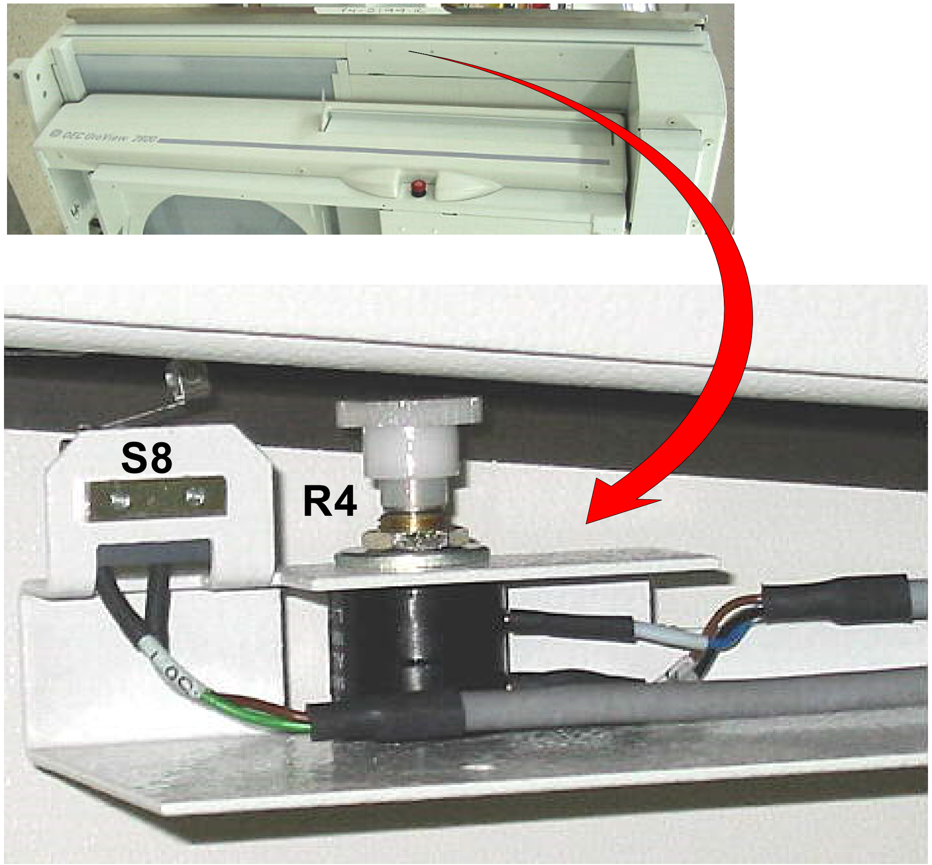
R4 provides feedback to the Motron CPU PCB about Table longitudinal movement. The Motron CPU PCB does an analog-to-digital (A/D) conversion of the voltage on R4's wiper. Motron software uses this information to determine the Table top's longitudinal position. It does this by comparing the digital value of the current longitudinal position with limits stored in the parameter list (the .hpp file).

S8 is a safety switch that can stop M4 if it drives the Table past either longitudinal software limit. This switch is normally closed. It opens when its roller runs past either end of the aluminum bar shown in the following picture. The aluminum bar runs the full length of maximum longitudinal Table travel. If the Table top moves past either software limit in the Calibration table, the switch travels past the end of the aluminum bar, opening S8. The open switch opens the circuit to motor relay K4 on the Relay PCB, stopping further M4 movement.



R4 and S8 Engaged in Aluminum Bar

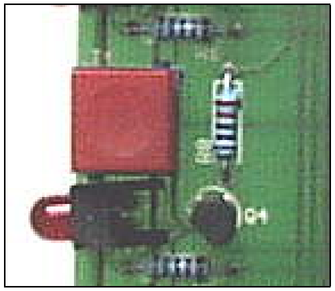
The following picture shows how to access S8 and R4. First, locate the access plate above the film slot. Next, loosen the screws that hold the access plate to the table. Loosen the screws on the left-hand side first, allowing the pot and switch to flex downward on the plate as shown.



Access to R4 and S8

Manual Override

If necessary, you can use red pushbutton switch T4 on the left edge of the Relay PCB to bypass the Safety stop Switch, enabling you to drive M4 back toward the Table center position. It's the fourth switch from the top



M4 Manual Override Button T4 on Relay PCB

CAUTION: *Be careful when using switch T4. It is possible to move the Table completely off the drive screws.*

Thermal Cutout

There is a thermal cutout switch that protects the motor in case it overheats. This device is also called T4, so don't confuse it with the manual override switch on the Relay PCB. The thermal cutout switch is normally closed, and wires in series with Safety Switch S8, connecting to the Relay PCB on connector X4B.   (All of the "B" connectors on the Relay PCB are for brakes or safety switches.)

Emergency Stop

Safety Switch S8, thermal switch T4, and interlock relay contacts on K3 and K5 connect in a series loop. The Emergency Stop +24 VDC circuit coming from the Motron CPU PCB and routed out of the Table Digital PCB and back to the Motron CPU PCB board (NOTAUS) powers the loop. Green LED V3 on the Table Digital PCB lights when the NOTAUS +24 VDC is present. After the Emergency Stop +24 VDC passes through the loop, it then powers the coil of relay K4 on the Relay PCB. The Motron CPU PCB controls the base of a Darlington transistor pair that connects the K4 coil to the +24 VDC ground on the Motron CPU PCB ground. When the Motron CPU PCB requests M4 motion and the motor's safety loop is intact, then K4 closes. When this happens, LED4 across K4's coil lights.

Motor Control

Click here for information on how the Motron CPU PCB operates the Relay PCB to control Motor M4. Note that M4 has no brake.

Collision Prevention

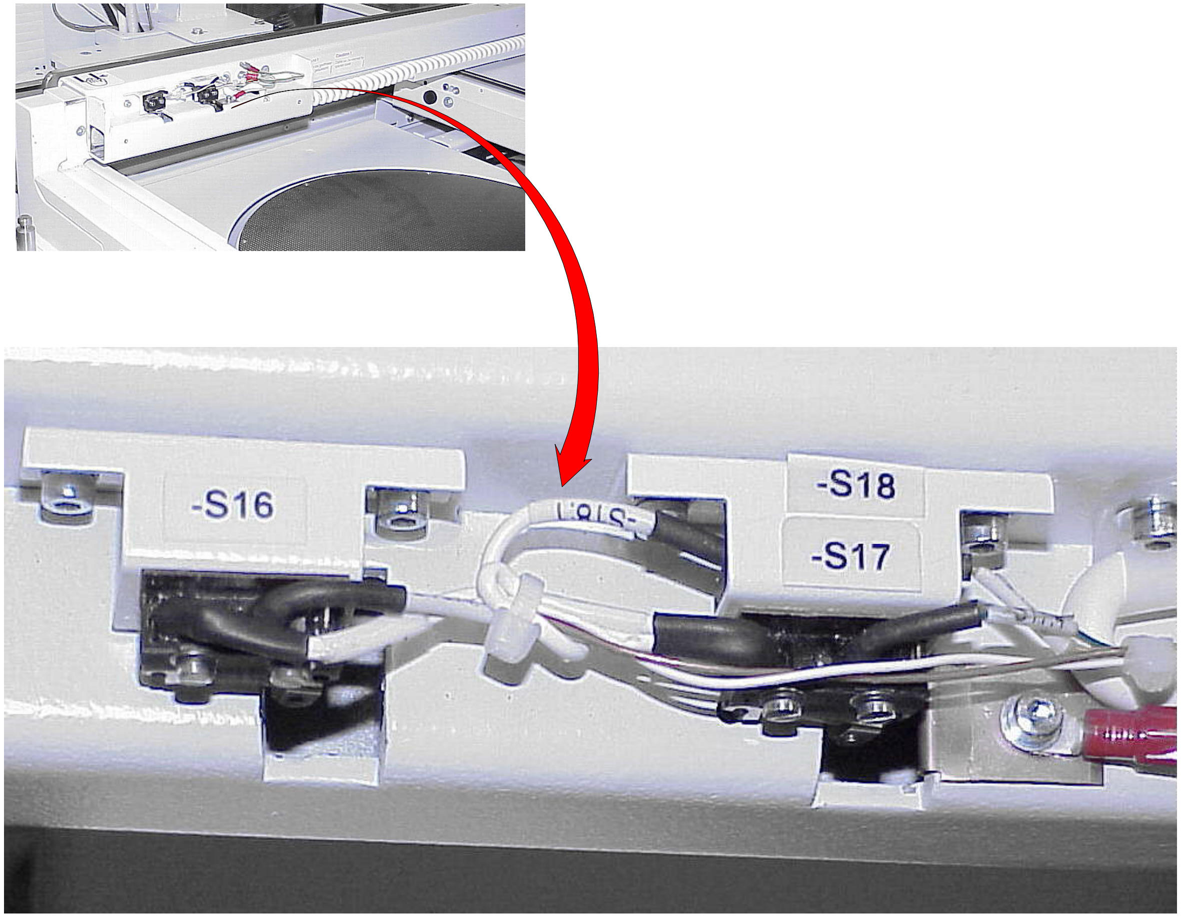
Switches S16, S17, and S18 in the Tabletop attachment tubes sense any installed tabletop accessory. The Motron CPU PCB identifies the attached accessory from the closed switches, and calculates Tabletop longitudinal motion stops for the attached accessory. This prevents Table accessories from striking the floor when the table tilts. Valid table accessories close S16 and either S17 or S18, but not both S17 and S18, according to the following table:

Accessory Detection Switch Details

Error	S16	S17	S18
Normal system state with no accessories installed	Open	Open	Open
Leg Extension installed	Closed	Closed	Open
Micturition Seat installed	Closed	Open	Closed
Unknown Table accessory not correctly installed	Closed	Open	Open
Unknown Table accessory not correctly installed	Closed	Closed	Closed
Table accessory not correctly installed	Open	Closed	Open
Table accessory not correctly installed	Open	Open	Closed
Table accessory not correctly installed	Open	Closed	Closed

Note: Installing an accessory with the system booted up generates an ACCESSORY INSTALLATION ERROR message on the VFDs. This is because S17 or S18 closes before the accessory's locking mechanism can close S16. This error will be logged but does not represent a failure unless the Table accessory is fully installed and locked.

Switches S16, S17, and S18 reside under an easy-to-remove access cover on the patient's right below the table top, as shown next. On a left-hand Table these switches will be on the patient's left. They will always be on the side of the Table closest to the X-ray arm.



S16, S17, and S18 Location

Connections from S16, S17, and S18 lead via a coiled cord to X6, an intermediate terminal block between the three switches and connector X4 on the Table Digital PCB. Refer to Table Digital PCB Schematic 885026 for more information. X6 is located at the head end of the Table in the same compartment with Motor M4. It is behind the belt tension bracket on the Tower side of the table.

Accessory Not Detected

When you install an accessory but the Table does not detect it, first check for +24 VDC. Probe X4-1 on the Table Digital PCB, using X1-3 or the anode of diode V1 as ground. If +24 VDC is not present, refer to Table Digital PCB Schematic 884244 and try to determine why.

S16 Check

This switch closes when an accessory properly latches to the Table. S16 closes in conjunction with S17 to identify the table extension, or in conjunction with S18 to identify the Micturition Seat. When S16 closes properly, there should be a short between X4-1 and X4-2 on the Table Digital PCB.

1. If there is no short, make sure the actuator engages the switch. If not, adjust the switch.
2. If the actuator engages the switch but there is no short, check the wiring and connections. If there is a short, remove X11 and check the connection at X11-1 and X11-21 on the Motron CPU PCB. Check for resistance of the cable, which should be a fraction of an ohm. Go to sheet 6 of Motron CPU PCB Schematic 884216 for more details.
3. Power up the system and check optoisolator IC10 on the Motron CPU PCB. Check pin 10, which is optically isolated from the Table Digital PCB. Pin 10 should be near digital ground (150mV) when its associated optoisolator is on, and pin 10 should be near +5 Volts when its associated optoisolator is off. Replace the Motron CPU PCB if this circuit is not working. Go to sheet 6 of Motron CPU PCB Schematic 884216 for more details.

S17 Check (Table Extension)

S17 along with switch S16 closes when you properly install the table extension. S18 should not close when you install the extension. Check connector X4 on the Table Digital PCB between pins 1 and 3 with the table extension installed. Verify that S17 closes. (You can see this circuitry on Table Digital PCB Schematic 885026).

1. If S17 does not close, make sure the actuator on the table extension engages the switch. If necessary, adjust the switch to engage the switch.
2. If the actuator engages the switch, but the circuit is still open, check the wiring and connections. If there is a short, check the connection on the Motron CPU PCB. You can test the accessory switch on connector X11 pins 1 and 22 on the Motron CPU PCB. Check the resistance of the cable. It should be a fraction of an ohm with X11 removed from the Motron CPU PCB, but not zero. You can see this circuitry on sheet 6 of Motron CPU PCB Schematic 884216.
3. Power up the system and check optoisolator IC10 on the Motron CPU PCB. Check pin 12, which is optically isolated from the Table Digital PCB. Pin 12 should be near digital ground (150mV) when its associated optoisolator is on, and pin 12 should be near +5 Volts when its associated optoisolator is off. Replace the Motron CPU PCB if this circuit does not work. Go to sheet 6 of Motron CPU PCB Schematic 884216 for more details.

S18 Check (Micturition Seat)

Only S16 and S18 should close when you install the Micturition seat. S17 should remain open. Use an ohmmeter to check the condition of S18 by probing connector X4 pins 1 and 4 on the Table Digital PCB. You should see a short. (You can view this circuitry on Table Digital PCB Schematic 885026.)

1. If you don't see a short on S18, make sure the actuator engages the switch. If necessary, adjust the switch.
2. If the actuator engages the switch, but the circuit is still open, check the wiring and connections. If there is a short, check the connection on the Motron CPU PCB. You can test the accessory switch on connector X11 pins 1 and 23 on the Motron CPU PCB. Check the resistance of the cable. It should be a fraction of an ohm with X11 removed from the Motron CPU PCB, but not zero. You can see this circuitry on sheet 6 of Motron CPU PCB Schematic 884216.
3. Power up the system and check optoisolator IC10 on the Motron CPU PCB. Check pin 14, which is optically isolated from the Table Digital PCB. Pin 14 should be near digital ground (150mV) when its associated optoisolator is on, and pin 14 should be near +5 Volts when its associated optoisolator is off. Replace the Motron CPU PCB if this circuit does not work. Go to sheet 6 of Motron CPU PCB Schematic 884216 for more details.

Table Top Logitudinal Movement Functional Test

Longitudinal movement of the Table is head-to-foot or foot-to-head movement of the tabletop. You can invoke this motion from the Table Hand Control, Collimator Housing Control, or Table Footswitch. Use any of these controls to check for proper longitudinal movement of the Table as follows:

1. Press head end longitudinal movement button or step on head-end longitudinal movement corner of footswitch pedal.
2. Verify that tabletop moves toward head end of table.
3. Verify that each vacuum fluorescent display (VFD) correctly reports tabletop position.
4. Verify that tabletop stops immediately when you release button or pedal.
5. Press foot end longitudinal movement button or step on foot-end longitudinal movement corner of footswitch pedal.
6. Verify that tabletop moves to foot end of table.
7. Verify that each VFD correctly reports table position.
8. Verify that tabletop stops immediately when you release pedal or button.

Error Messages

Longitudinal Table movement failures can generate the following error messages. Displayed messages appear on the VFDs and logged Table Messages appear in the recorded Error Log. Click on the hyperlinked messages to see recommended cures.

Longitudinal Table Movement Error Messages

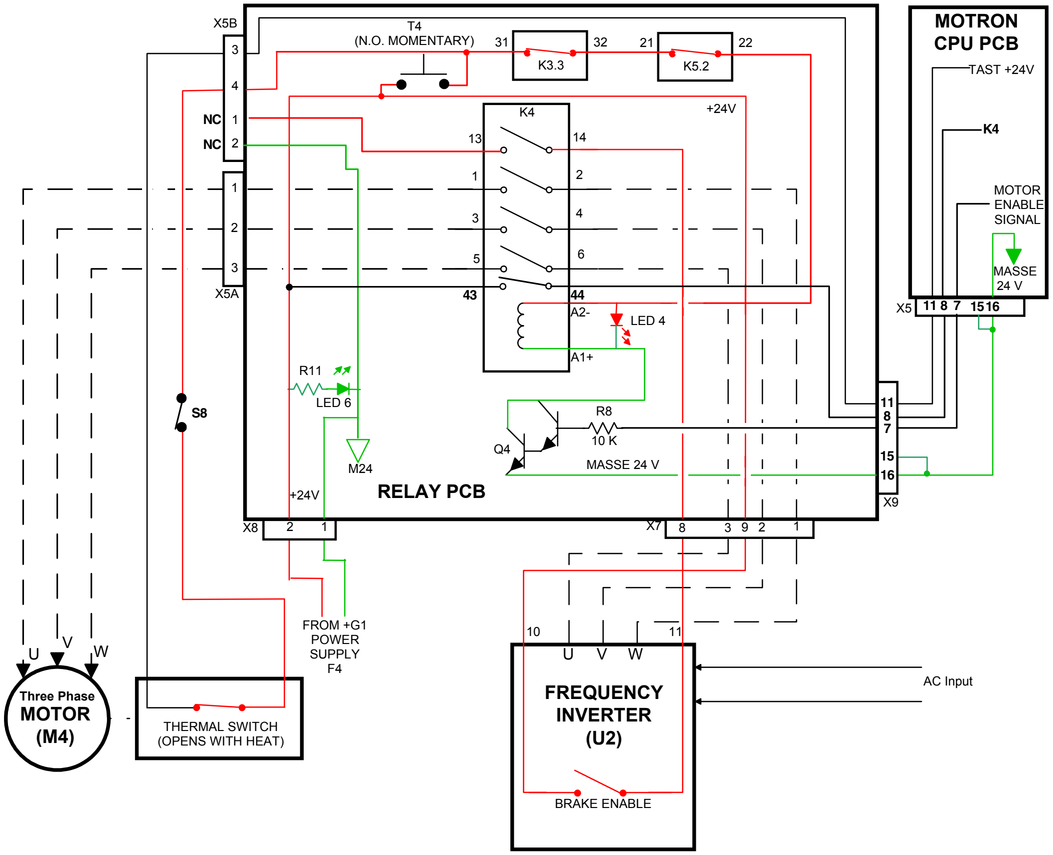
Error	Displayed Message	Logged Message	Code
Unknown table accessory not correctly installed	ACCESSORY INSTALLATION ERROR	TBL UNKNOWN ACCESSORY INSTALLATION ERROR	40
Table accessory not correctly installed	ACCESSORY INSTALLATION ERROR	TBL ACCESSORY INSTALLATION ERROR	41
Longitudinal Motion Stopped due to Calculated Motion Limit	*LONG MOTION LIMITED	None	85
Motor M4 Problem - Table Longitudinal	MOTION FAILURE - 53	TBL LONG MOTOR PROBLEM	53
Longitudinal Motion Blocked/Potentiometer Problem	MOTION FAILURE -65	TBL LONG MOTION FAILURE	65
Limit Switch or gearbox overheating Problem M4	MOTION FAILURE - 73	TBL LONG LIMIT OR OVERHEAT	73
Frequency Inverter 1 for tilt/vertical, longitudinal, cassette out of order	MOTION FAILURE - 102	TBL FREQ CONVERT 1 ERROR	102

Error	Displayed Message	Logged Message	Code
Analog voltage failed	TABLE COMMUNICATIONS FAILED (line 1) CALL SERVICE - 61 (line 2)	TBL ANALOG VOLTAGE FAILED	61
Potentiometer Table Top Longitudinal M4 Status	*TABLE LONG AT LIMIT	None	None
Potentiometer Table Top Longitudinal M4 Status	*LONG = xx	None	None

*Information message only

Troubleshooting

Use the following detailed block diagram and procedure to help you identify a consistent Table longitudinal motion (head-to foot, or foot-to-head) failure.


X5B
T4
(N.O. MOMENTARY)
31
K3.3
32
21
K5.2
22
MOTRON
CPU PCB
TAST +24V
K4
MOTOR
ENABLE
SIGNAL
MASSE
24 V
X5
11 8 7 15 16
NC
NC
K4
+24V
13
14
1
2
3
4
5
6
43
44
A2-
A1+
LED 4
X5A
R11
LED 6
S8
M24
R8
10 K
Q4
MASSE 24 V
+24V
RELAY PCB
11
8
7
15
16
X9
X8
2
1
X7
8
3
9
2
1
FROM +G1
POWER
SUPPLY
F4
U
V
W
Three Phase
MOTOR
(M4)
THERMAL SWITCH
(OPENS WITH HEAT)
10
11
U
V
W
FREQUENCY
INVERTER
(U2)
AC Input
BRAKE ENABLE

Motor M4 Detailed Block Diagram

M4 Problems

Question	Yes	No
1. Do Motors M3 and M5 both work?	Step 2	Motion Failure -102
2. Analog Voltage Error Code 61?	Table Communications Failed / Call Service - 61	Step 3.
3. Does longitudinal motion fail from all controls?	Step 4	Go to Key Controls Section for help in troubleshooting the failing control.
4. Limit Switch Error 73?	Step 5	Step 7
5. Is M4 Calibration OK?	Motion Failure -73	Motion Failure - 65
6. Problem solved?	End	Step 7
7. Does Motor start and then stop, giving an Error 65?	Motion Failure - 65	Step 8
8. Is Potentiometer R4 OK?	Step 9	Replace R4
9. Is Drive Belt OK?	Step 10	Replace drive belt
10. Is Motor M4 operating correctly?	Step 11	Motion Failure - 53
11. Use the Utility Suite to watch line M6 in the Analog Test window. Is pot value between 25 and 1000?	Step 12	Replace R4 and recalibrate M4 motion
12. Problem solved?	End	Call Technical Support

ACCESSORY INSTALLATION ERROR - 40

This message appears when you attempt to install an unknown table accessory.

ACCESSORY INSTALLATION ERROR - 41

This message appears when you install a valid Table accessory incorrectly.

Note: Each time you install a Table extension with the system on, you will get this message. This happens because S17 or S18 closes before the locking mechanism on the extension can close S16. The message goes away after the extension is fully locked in place.

LONG MOTION LIMITED

This message appears on the VFDs when the Table reaches a software-calculated motion limit based on an accessory currently installed on the Table. Switch S16 along with S17 or S18 close when you install the accessory. The Motron CPU PCB determines from the closed switches which accessory it is, and calculates the new tabletop longitudinal, tilt, and down motion stops necessary to protect that accessory and the Table operator. Click here for more information on switch closures associated with each Table accessory.

MOTION FAILURE - 53

This message indicates a possible failure of K4 on the Relay PCB.

1. **Check the +24 VDC power on the Relay PCB**. You can measure this voltage on connector X8 pins 1 and 2. Use pin 1 as ground. Make sure that LED 6 on the Relay PCB lights to indicate that +24 VDC is present. Refer to Relay PCB Schematic 884219, page 1 of 3).
2. **Check Motron CPU PCB connector X9 on the Relay PCB**. You can remove this cable to make these measurements. X9 pin 8 indicates the status of the K4 relay. When the relay is active, pin 8 should have +24 VDC on it. If +24 VDC is on pin 8 when K4 is inactive, the relay is probably stuck closed. Replace the Relay PCB if relay K4 is not working correctly. Refer to Relay PCB Schematic 884219, pages 1 and 3.
3. **Check the Motron CPU PCB optoisolator**. The Motron CPU PCB connects by X5 to the Relay PCB. Check optisolator IC13 pin 10. This pin will be near digital ground (150mV) when K4 is active (closed) and at +5 VDC when K4 is inactive (open). Replace the Relay PCB if K4 is not working. Refer to Motron CPU PCB Schematic 884216 page 3 of 13. for more information.

MOTION FAILURE - 65

This is a general motion failure that the Motron CPU PCB asserts when it determines that Potentiometer R4 is not moving when it should be. The actual cause of this error may be a broken pot, bad power to the pot or to Motor M4, mechanical blockage or binding, or a broken belt.

1. **Check for Pot R4 Problems**:
    - a. Turn on system power and let the Table boot fully.
    - b. Remove the Table Tower's top cover.
    - c. Connect your laptop to the serial port, and enter the Service mode.
    - d. Open the Utility Suite and select the Motron tool option.
    - e. Open the oec_new.hpp file and select the Read CPU button.
    - f. Select the Monitor button to open up a new window.

g. Select option 2 to enter the Analog Test window.

h. Check the M4 line in the Analog Test window. If the value is between 25 and 1000, the pot is probably OK. If the value is outside this range, Table software does not allow longitudinal Table movement and generates this error. Possible cause of this error are broken pot gear, bad potentiometer, bad analog 5 VDC, or analog ground bad or missing.

i. Check the pot as follows:

  (1) Gain access to R4's cover under the carbon fiber tabletop.

  (2) Make note of potentiometer value on the M4 line and save this information for later use.

  (3) Move the tabletop laterally from the tower. Remove four of the five screws from the lower plate that holds the potentiometer and switch. Move plate slightly downward to disengage the pot gear. You may have to loosen the fifth screw for this plate to angle down easily.

  (4) Check pot gear for cracks.

  (5) While looking at the Analog Test window, spin the pot gear and see if the value on line M4 changes.

  (6) Move the pot back to the value you recorded in step (2). Engage the pot gear to the Table rack. Reinstall the screws you removed in step (3).

  (7) Check the R4's resistance by removing the plug from connector X13 on the Motron CPU PCB. The pot connects to pins 6, 13 and 14 on the plug, with the wiper connecting to pin 6. You should see 10K ohms between pins 13 and 14 on the pot plug when it is disconnected from X13. You can see connector X13 on Schematic 884216 page 8.

  (8) Check the voltage on X13 on the Motron CPU PCB. Look for +5 VDC between pins 13 and 14. Pin 14 is the analog ground pin. Check the wiper voltage between pins 6 and 14. Make sure LED D30 is lit, which is the voltage reference to the CPU's A/D converter. You can see LED D30 on Schematic 884216 page 11.

2. **Make sure the tabletop longitudinal belt is not broken**. Check the belt for correct tension. A deflection of 3/8 inch (10mm) should require a force of 8.5 pounds (35N).

3. **Check motor power on connector** X4A **on the Relay PCB**. Make sure wires on connector are fully inserted. Check voltage between phases. Measure between pins 1 and 2, pins 1 and 3, and pins 2 and 3. All phases should measure the same when the motor is running. Refer to Relay PCB Schematic 884219 page 2, and to Motor 4 Wiring Diagram 885022 for more information.

4. **Check thermal switch T4 and limit switch S8.** Measure the resistance between pins 3 and 4 on connector X4B on the Relay PCB. You should see continuity at 0.7 ohms. The thermal switch is normally closed and open when the motor is overheated. Limit switch S8 is normally closed and engaged with the aluminum actuator bar.. Refer to Relay PCB Schematic 884219 page 2, and to Motor 4 Wiring Diagram 885022 for more information.
5. **Check** Connector X16. X16 is the large connector near M4. Its pins are marked in rows 1 through 5 and columns A, B, and C. Disconnect the connectors by pulling the locking lever and pulling them apart. Inspect the pins. Use an ohmmeter to measure the resistance between the pin pairs identified in the table below. You can perform the same test on Relay PCB connectors X4A and X4B.

Typical Resistance Between Connector X16 Pins

Function	X16 Pin Pair	Resistance
Motor Coil	A1-B1	36Ω
Motor Coil	A1-C1	36Ω
Motor Coil	B1-C1	36Ω
Jumper	B2-B3	0.1Ω
Limit Switch S8	A3-B3 (female)	0.4Ω
Limit Switch S8	A3-B3 (male)	open
Thermal Switch	A3-B3	0.1Ω

8. **Make sure both longitudinal movement screws operate freely.** Inspect all mechanical parts associated with longitudinal movement. Make sure they all move freely and do not bind.
9. **Check Fuse F3**. F3 is the current limiter for Frequency Inverter U2. Refer to Table Power Supply Schematic 885025 for more information

MOTION FAILURE - 73

The Motron CPU PCB generates this error when the series loop circuit composed of limit switch S8, Motor M4's thermal switch T4, interlock Relay K3, and interlock Relay K5 opens. The best spot to find the open is to check the connections on X16 near Motor M4. To make a thorough check, follow this procedure:

1. **Check continuity between pins 3 and 4 on connector X4B**. If the loop is open, the failure is associated with switch S8 or thermal switch T4. If the loop is closed, go to step 8, below. For more information, refer to Relay PCB Schematic 884219, page 2, or to Motor M4 Wiring Diagram 885022.
2. **Check the +24 VDC power on the Relay PCB**. Measure between pins 1 and 2 on connector X8, using pin 1 as ground. Make sure LED 6 lights when +24 VDC is present. Refer to page 1 of the Relay PCB Schematic 884219 to see this circuitry.
3. **Check for +24 VDC on** X9 pin 8 **on the Relay PCB**. This pin indicates the status of Relay K4. When the relay is inactive, pin 8 should not have +24 VDC on it. This is an indication that the relay is stuck closed. Pin 8 has +24 VDC on it when K4 is active. Replace the Relay PCB if K4 is not working correctly. You can see this circuitry on page 1 of Relay PCB Schematic 884219.
4. **Check position of actuator on Switch S8**. The switch actuator must always rest somewhere on the aluminum bar. If it doesn't, recalibrate Table longitudinal motion. If necessary, use Switch T4 on the Relay PCB to move the tabletop into position so the actuator for S8 is back on the aluminum bar.
5. **Check switches connected to** X16. Disconnect the plug from connector X16 and use an ohmmeter along with the following table to determine which switch is open. You can view this circuit on Motor M4 Schematic 885022.

Switch S8 and T4 Contacts on Connector X16

Device	X16 Pin Pair	Resistance
Limit Switch S8	A3-B3 (female)	0.4Ω
Thermal Switch T4	A3-A2	0.1Ω

6. **Verify correct operation of Limit Switch S8**. Connect an ohmmeter across X16 pins A3 and B3. Lower Limit Switch S8 from the Table and actuate the switch lever. Verify that you can see a continuity of .4 ohms when you press the switch lever. If the switch doesn't close, replace the switch. You can view this circuit on Motor M4 Schematic 884022.
7. **Verify correct operation of Thermal Switch T4.** Check resistance between pins A3 and B3 on X16. Verify a continuity of .1 ohms when the motor is cool. If the motor is obviously hot, verify that T4 opens. Try to determine cause of a hot motor by looking for mechanical binding or blockage. Use the data in the following table to look for opens or shorts in the motor coils.

Motor M4 Contacts on Connector X16

Device	X16 Pin Pair	Resistance
Motor Coil	A1-B1	36Ω
Motor Coil	A1-C1	36Ω
Motor Coil	B1-C1	36Ω
Jumper	B2-B3	0.1Ω
Chassis Ground	C5-Chassis	0.1Ω

8. **Check for a closed loop on** Relay PCB connector X4B **pins 3 and 4**. An open circuit here indicates that relay K3.3 and/or K5.2 is not closed as it should be. Refer to Relay PCB Schematic 884219, page 2, for more information.
9. **Check the interlock relays K3 and K5**. Power down the Table. Connect an ohmmeter between Relay PCB Connector X8 pin 2 (+24 VDC) and the cathode of flyback diode D4 across the coil on relay K4. The ohmmeter should read open when Override Switch T4 is not pressed, and zero ohms when it is. If you get different results, Relay K3 or K5 is bad. Replace the Relay PCB. Refer to sheets 1 and 2 of Relay PCB Schematic 884219 to see this circuitry.
10. **Check the coil resistance on Relay K4**. Connect your ohmmeter across flyback diode D4 across the coil on relay K4. (Be careful not to forward bias the diode.) With the diode not conducting, you should see a coil resistance of 183 ohms. Replace the Relay PCB if K4's coil appears to be shorted or open. Refer to sheet 2 of Relay PCB Schematic 884219 to see this circuitry.

11. **Check Motor M4's control signal on the Relay PCB**. Connect your voltmeter between X8 pin 1 (+24 VDC GND) and X9 pin 7 or the top end of R8 near T4 (K4) on the Relay PCB. Power up the system and attempt to move the Tabletop longitudinally. When the motor runs, the voltage on X9 pin 7 should be close to +24 VDC. When the Table movement stops, the voltage should drop to near 0 volts. Refer to Relay PCB Schematic 884219 pages 1 and 2 to see this circuitry.
12. **Check Motor M4's control signal on the Motron CPU PCB**. Connect a voltmeter between X1 pin 4 (GND) and X5 pin 7. When you move the tabletop longitudinally by operating M4, the voltage on pin 7 should be close to +24 VDC. When M4 is not running, this same pin should be near 0 Volts. Refer to sheets 3 and 11 on Motron CPU PCB Schematic 884216 to see this circuitry.
13. **Check the cable between the Motron CPU PCB and the Relay PCB**. The cable runs between X5 on the Motron board and X9 on the Relay PCB. Refer to Table Schematic 885015 for more details.
14. **Check optoisolator IC11 on the Motron CPU PCB.** For ground, connect your voltmeter to the heat tab or pin 1 of IC12 (the +5 Volt regulator). Connect the other meter lead to pin 8 of optoisolator IC11. When motor M4 runs, the voltage on pin 8 should be close to ground. When motor M4 is off, pin 8 should be at +5 VDC. If you get different results, replace the Motron CPU PCB. Refer to sheets 3 and 11 on Motron CPU PCB Schematic 884216 to see this circuitry.

MOTION FAILURE - 102

This error message is an indication that Fuse F3 on the Table Power Supply may be open. This fuse limits current to Frequency Inverter U2. Refer to Table Power Supply Schematic 885025 for more details.

TABLE COMMUNICATIONS FAILED / CALL SERVICE - 61

This error message is usually an indication that the analog +5 VDC (Vref) voltage to the Motron CPU PCB's analog-to-digital converter is bad.

1. Check LED 30 on the Motron CPU PCB. This LED should be lit because it monitors the input to the analog +5 VDC supply. If LED 30 is off, check Fuse F2 on the Motron CPU PCB. Refer to sheet 11 of Motron CPU PCB Schematic 884216 to see this circuitry.
2. **Check the voltage on connector** X14 **on the Motron CPU PCB**. Use pin 3 or 6 on this connector as the ground reference. Use pin 1 or 4 as the analog +5 VDC voltage. If +5 VDC is not present, replace the Motron CPU PCB. Refer to sheet 8 of Motron CPU PCB Schematic 884216 to see this circuitry.
3. **Remove plugs from connectors X13 and X14 to unload the +5 VDC supply**. Remove all connectors to the position-reporting potentiometers and check the analog +5 VDC supply. Determine which connector loads down the supply. After you do that, find the short in the cable or pot. Refer to sheet 8 on Motron CPU PCB Schematic 884216 to see this circuitry.
4. **Check voltage reference to Motron CPU PCB's analog-to-digital converter**. Use pin 3 or 6 on connector X14 as the ground reference. Check the voltage on both sides of resistor R67 near connector X14. One side of the resistor should be at about +9 VDC and the other side should be at +4.99 VDC. If you get different results, replace the Motron CPU PCB. Refer to sheet 11 on Motron CPU PCB Schematic 884216 to see this circuitry.

TABLE LONG AT LIMIT

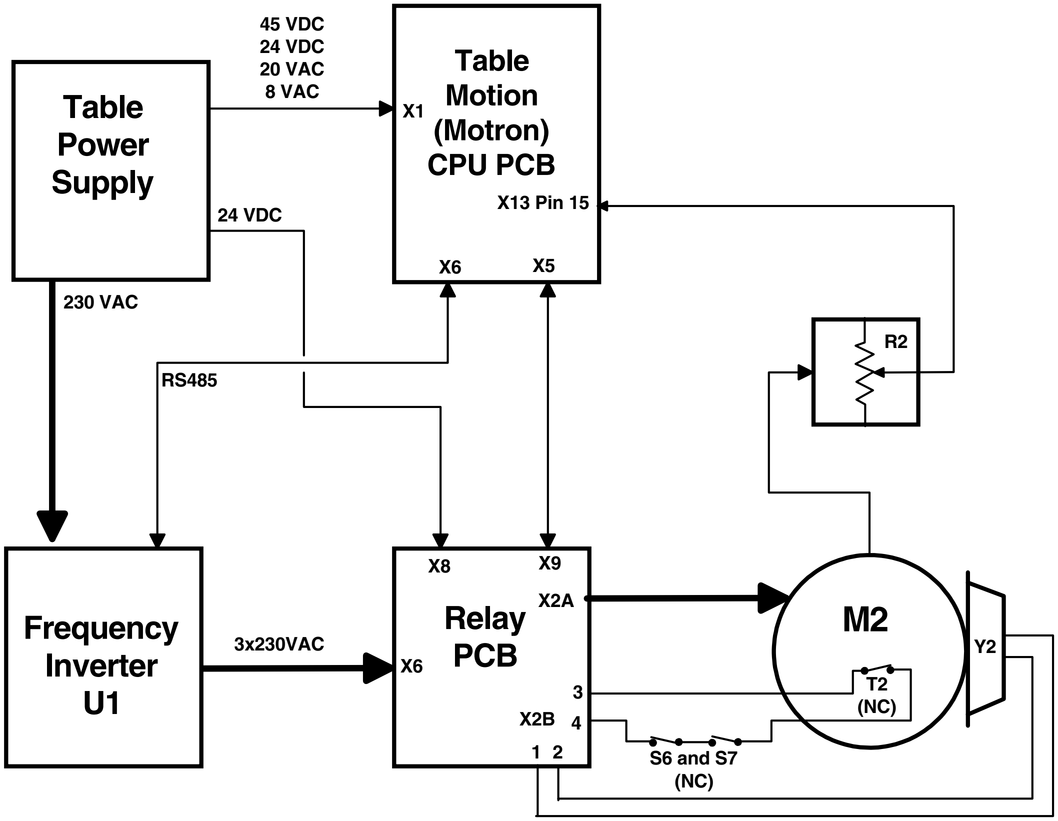
This is an information-only message on the vacuum fluorescent display (VFD) that tells you the Tabletop is at the software calibration limit.

LONG = xx

This is an information-only message on the vacuum fluorescent display (VFD) that tells you the current Tabletop longitudinal position in centimeters from the center position. (One inch equals 2.54 centimeters.)

Image Chain Longitudinal Movement (M2)

The following paragraphs describe the circuitry that performs longitudinal (head-to-foot and foot-to-head) movement of the Image Chain, which includes the X-ray Tube and X-ray Arm above the Table, and the Image Intensifier and CCD camera below the Table. For additional details not shown in this diagram, please click the Schematics button at the bottom of this page.


45 VDC
24 VDC
20 VAC
8 VAC
Table Power Supply
Table Motion (Motron) CPU PCB
X1
X13 Pin 15
24 VDC
X6
X5
230 VAC
R2
RS485
X8
X9
X2A
M2
Y2
Frequency Inverter U1
3x230VAC
Relay PCB
X6
3
T2
(NC)
X2B
4
1 2
S6 and S7
(NC)

Motor M2 Image Chain Movement Circuitry

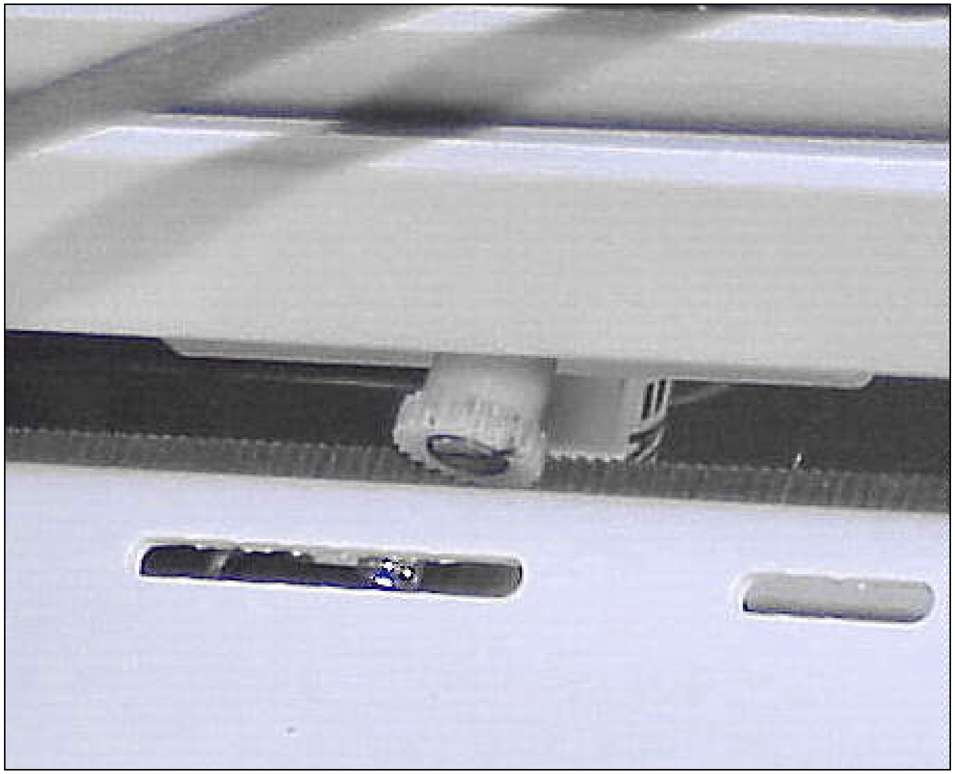
Overview

Use the Table Hand Control, Table Footswitch, or Collimator Control Panel to initiate movement of the Image Chain. Motor M2 only responds to Image Chain movement commands when the system is in Fluoro mode. When the system is in Film mode, the Image Chain only moves to the film position and stays there. Once the Image Chain is in Film position and the system remains in Film mode, you can't move the Image Chain any further until you return the system to Fluoro mode.

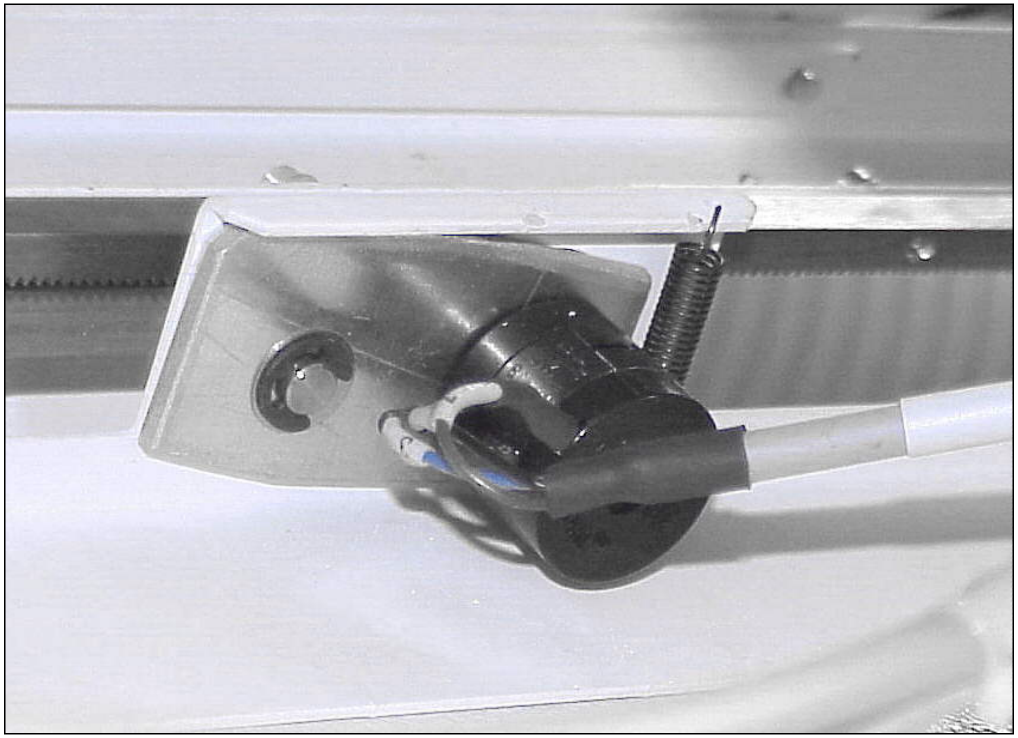
Image Chain movement can occur only while you're holding a key down. The Table Motion CPU PCB won't allow movement unless the key closes both the movement circuit and the security line, and keeps both lines closed for the duration of the movement.

Motor M2 and Potentiometer R2

Motor M2 drives a screw that moves the Image Chain longitudinally. A track on the Image Chain carriage turns stationary feedback pot R2, providing Image Chain position information back to the Motron CPU PCB. The CPU does an analog-to-digital conversion of the pot voltage, and compares this digital information with stored parameters to determine current Image Chain position.



Potentiometer R2 Lower View

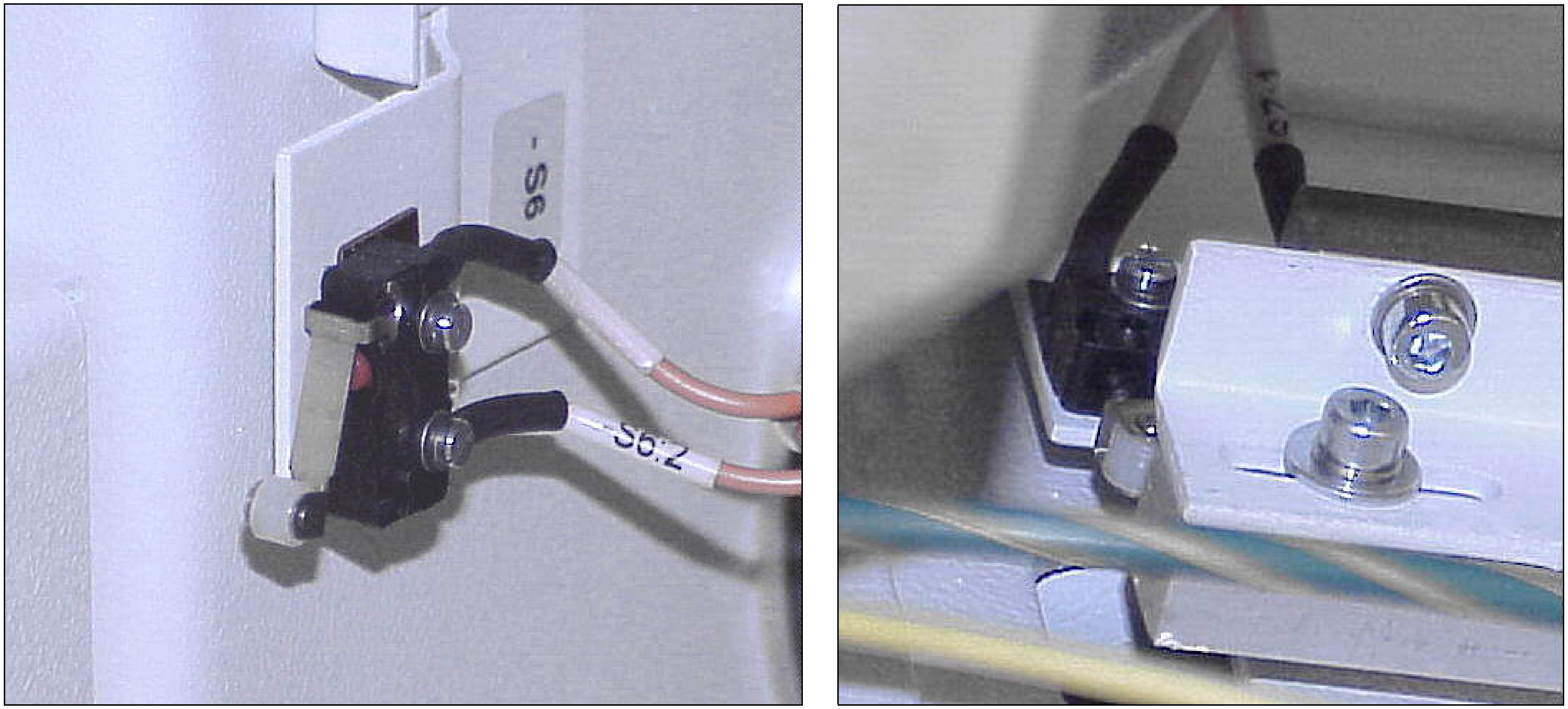


Potentiometer R2 Upper View

The Motron CPU PCB controls motor M2 through an RS-485 serial line to Frequency Inverter U1. The Frequency Inverter processes single-phase 230 VAC input to produce pulse-width modulated, 3-phase AC to Motor M2. Varying the duty cycle controls the starting direction and running torque of M2. Varying the frequency controls motor speed.

Safety Switches S6 and S7

S6 and S7 shown in the above block diagram provide mechanical safety stops for Image Chain longitudinal movement. If Image Chain movement passes a software limit, one of these switches encounters an aluminum bar that opens the switch. When either switch opens, it interrupts current to Relay K2, which controls power to Motor M2. M2 stops, and so does Image Chain movement.



Limit Switch S6 and Limit Switch S7 Engaging Actuator Bar

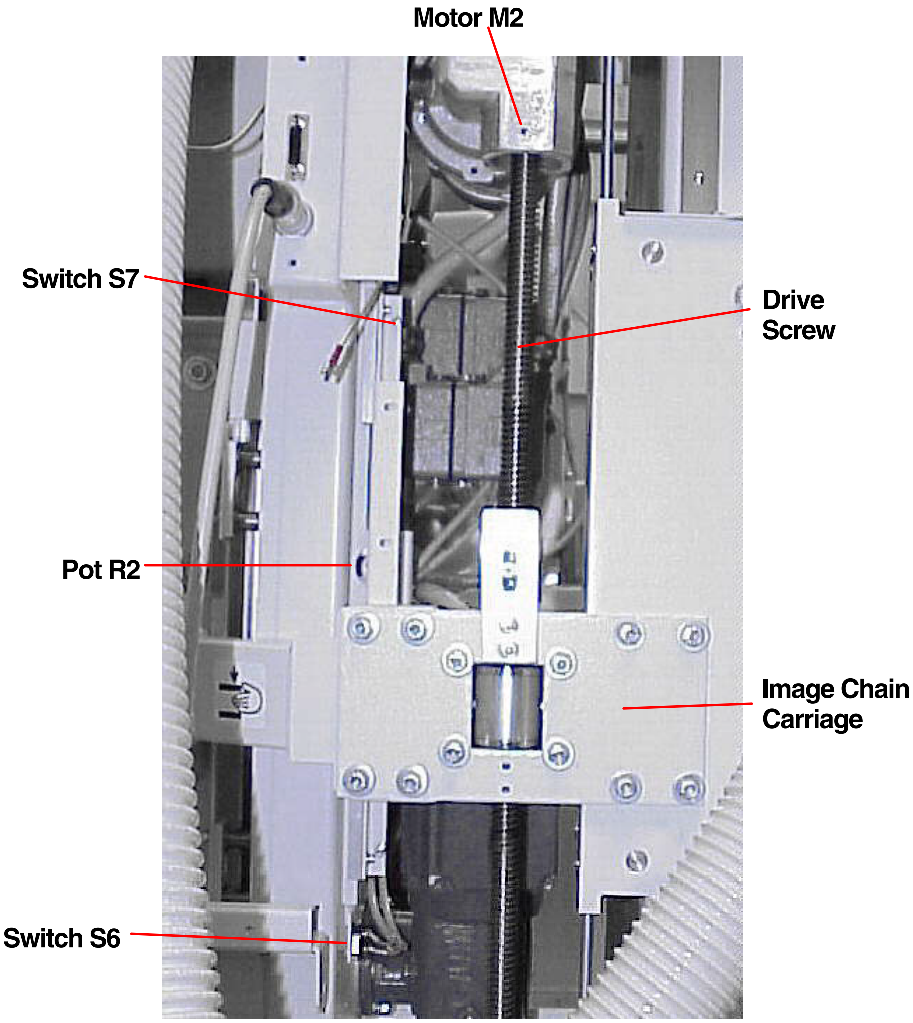

Motor M2
Switch S7
Drive Screw
Pot R2
Image Chain Carriage
Switch S6

Image Chain Movement Mechanics - Lower View

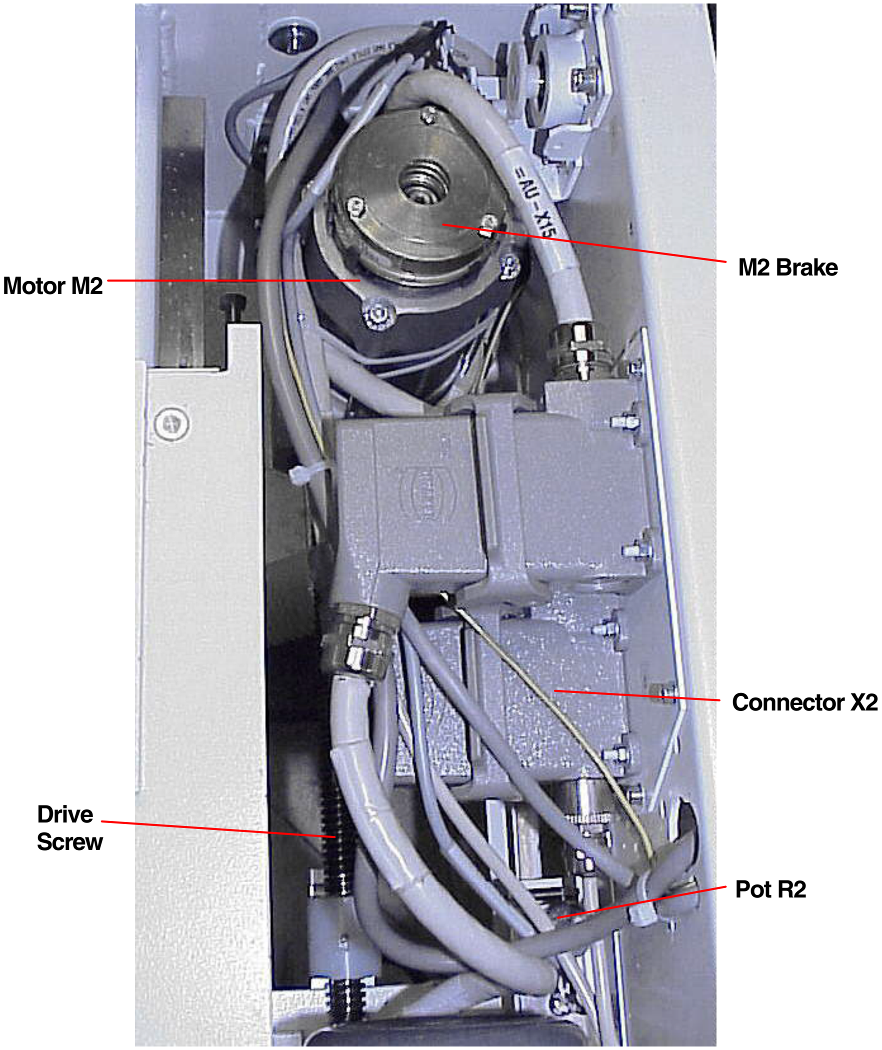
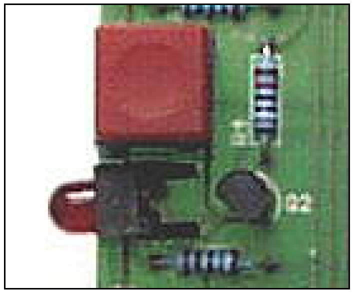

Motor M2
M2 Brake
=AU-X15
Connector X2
Drive Screw
Pot R2

Image Chain Movement Mechanics - Upper View

Manual Override

If the Image Chain movement opens S6 or S7, you can't use a key control to move the Image Chain back in proper position unless you press Manual Override switch T2. This switch is located on the Relay PCB, as shown in the following picture. Press and hold switch T2 and use one of the key controls to move the Image Chain back into its valid range of motion.

CAUTION: Be very careful when using switch T2. You can cause extensive damage by moving the Image Chain in the wrong direction.



Manual Override Switch T2

Motor M2 Thermal Protection

Thermal switch T2 (not to be confused with the manual override switch T2) shuts off motor M2 if the motor gets too hot. The thermal switch is normally closed, and wires in series with switches S6 and S7, which are also normally closed. If this series safety loop opens, M2 won't run. T2 appears in block diagram Motor M2 Image Chain Movement Circuitry, shown previously in this discussion.

Emergency Stop

The series safety loop connects to the Relay PCB on connector X2B pins 3 and 4.The safety loop receives its power from the Emergency Stop +24 VDC circuit on the Motron CPU PCB. This circuit leaves the Motron board, travels to the Table Digital PCB, and returns to the Motron board (NOTAUS). Green LED V3 on the Table Digital PCB lights when the NOTAUS +24 VDC is present.

Note: All of the Relay PCB connectors that have a "B" in their reference designator (X2B, for example) are for the brakes or safety switches of each motor. Pins 1 and 2 are for brakes, with pin 2 being ground. Pins 3 and 4 are for motor safety switches.

Safety switches S6 and S7, thermal switch T2, and one interlock relay contact on relay K1 wire in a series loop powered by the Emergency Stop +24 VDC power supply from the Motron CPU PCB. After the Emergency Stop +24 VDC passes through the loop, it then powers the coil of Relay K2 on the Relay PCB. The Motron CPU PCB controls the base of a Darlington transistor pair that connects K2's coil to the 24 VDC ground on the Motron CPU PCB. When the Motron CPU PCB requests Motor M2 and the motor's safety loop is closed, K2 closes. When this happens, LED 2 across K2's coil lights.

Motor M2 Control and Brake

Frequency Inverter U1 responds to commands from the Motron CPU PCB to provide drive power to Motor M1 or M2. U1 can't power both motors at once. Relays on the Relay PCB switch power from U1 to the proper motor. K1 supplies power to Motor M1 and K2 supplies power to M2. A normally-closed contact on K1 is in series with the coil of K2, and a normally-closed contact on K2 is in series with the coil of K1. This makes it impossible for Frequency Inverter U1 to power both motors at once.

Three-phase power from U1 enters M2 through connector X2A on the Relay PCB.

Note: All Relay PCB connectors that have an "A" in their reference designator (X2A, for example) supply three-phase power to a motor.

M2 has a brake (Y2) that engages at all times except when +24 VDC is applied to it. When Frequency Inverter U1 applies three-phase AC power to M2, it also closes an internal relay that applies +24 VDC through Relay PCB connector X2B to the brake's solenoid, releasing the brake.

Image Chain Longitudinal Movement Functional Test

Longitudinal movement of the X-ray Arm is motion of the entire Image Chain (X-ray Tube, Collimator, Image Intensifier, and CCD camera) from head to foot or foot to head while the Table itself remains stationary. You can invoke longitudinal movement of the Image Chain from Table Hand Control, Collimator Housing Control, or Table Footswitch. Use any of these controls to perform the following test:

1. Press the X-ray Arm Left movement button or step on the equivalent Table Footswitch control.
2. Verify that the X-ray Arm immediately moves smoothly and quietly to the left.
3. Verify that the longitudinal movement of the X-ray Arm ceases when you release the button or Table Footswitch.
4. Press the X-ray Arm Right movement button or step on the equivalent Footswitch control.
5. Verify that the X-ray Arm moves to the right.
6. Verify that the longitudinal X-ray Arm movement ceases when you release the button or Table Footswitch.

Error Messages

Image Chain movement and related functional failures can generate the following error messages:

Image Chain Movement Error Messages

Error	Displayed Message	Logged Message	Code
X-ray Arm and Cassette not centered during Film mode request	FILM FAILURE - 36	TBL IMAGE CHAIN NOT CENTERED	36
Motor M2 Problem - X-ray Arm Assembly	MOTION FAILURE -55	TBL IMAGE CHAIN MOTOR PROBLEM	55

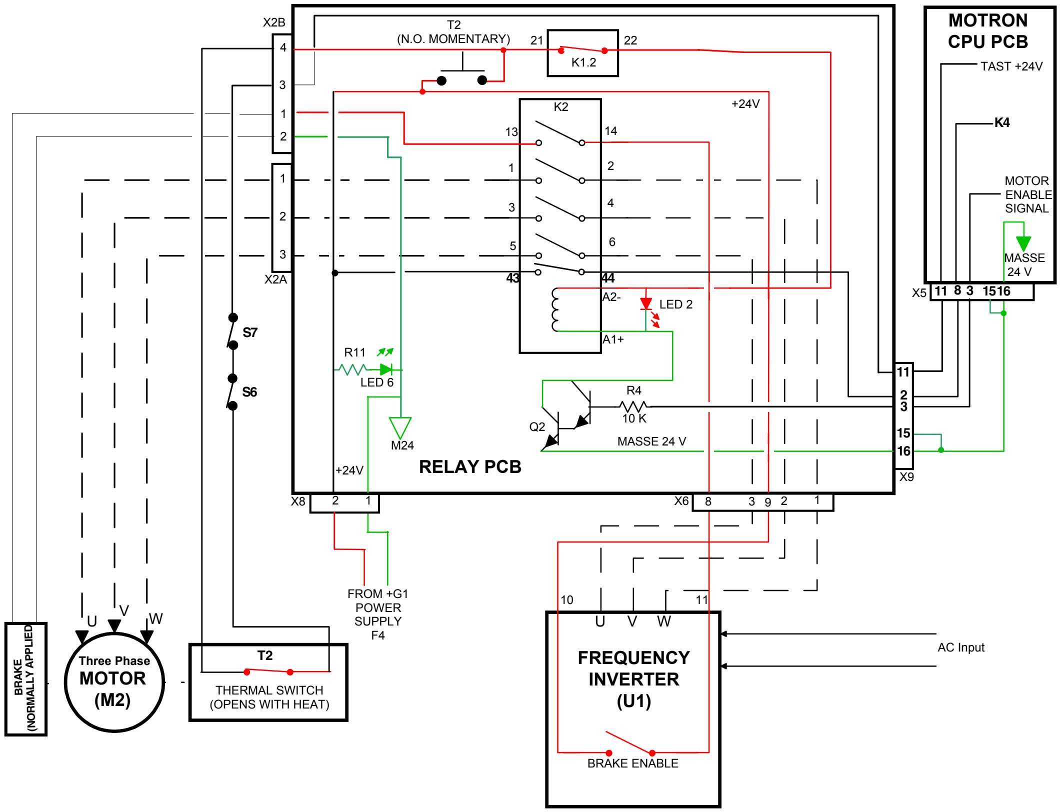
Error	Displayed Message	Logged Message	Code
Analog voltage failed	TABLE COMMUNICATIONS FAILED (line 1) CALL SERVICE - 61 (line 2)	TBL ANALOG VOLTAGE FAILED	61
X-ray Arm Assembly Motion Blocked/ Potentiometer Problem	MOTION FAILURE -66	TBL IMAGE CHAIN MOTION FAILURE	66
Relay FU0 Frequency Problem - Motor Operating in Error	CALL SERVICE -67	TBL FL0 FREQUENCY PROBLEM	67
Limit Switch or gearbox overheating Problem M2	MOTION FAILURE - 72	TBL IMAGE CHAIN LIMIT OR OVERHEAT	72
Frequency Inverter 0 for tilt/vertical, image chain out of order	MOTION FAILURE - 101	TBL FREQ CONVERT 0 ERROR	101
X-ray Arm Assembly to Center Position Reached	*FILM MODE READY	None	None
Potentiometer X-ray Tube Arm M2 Status	*X-RAY ARM = xx	None	None
Potentiometer X-ray Tube Arm M2 Status	*X-RAY ARM AT LIMIT	None	None
Potentiometer X-ray Tube Arm M2 Status	*X-RAY ARM CENTERED	None	None

*Information message only

Note: FU0 is the same as Frequency Inverter U1. FU1 is the same as Frequency Inverter U2.

Troubleshooting

Use the following detailed block diagram and procedure to help you identify a consistent Image Chain longitudinal motion (head-to foot, or foot-to-head) failure.


X2B
T2
(N.O. MOMENTARY)
21
K1.2
22
MOTRON
CPU PCB
TAST +24V
K4
MOTOR
ENABLE
SIGNAL
MASSE
24 V
X5
11 8 3 1516
K2
+24V
13
14
1
2
3
4
5
6
43
44
A2-
A1+
LED 2
X2A
S7
S6
R11
LED 6
M24
R4
10 K
Q2
MASSE 24 V
RELAY PCB
+24V
X8
2 1
X6
8 3 9 2 1
X9
11
2
3
15
16
FROM +G1
POWER
SUPPLY
F4
U
V
W
BRAKE
(NORMALLY APPLIED)
Three Phase
MOTOR
(M2)
T2
THERMAL SWITCH
(OPENS WITH HEAT)
10
11
FREQUENCY
INVERTER
(U1)
BRAKE ENABLE
AC Input

M2 Detailed Functional Block Diagram

M2 Problems

Question	Yes	No
1. Does Motor M1 work?	Step 4	Step 2.
2. Analog Voltage Failure Error 61?	TABLE COMMUNICATIONS FAILED CALL SERVICE - 61	Step 3.
3. Motion Failure Error 101?	MOTION FAILURE -101	Step 4
4. Film Failure Error 36?	FILM FAILURE - 36	Step 5
5. Is film cassette and X-ray system alignment OK?	Step 6	Calibrate film cassette and X-ray system alignment
6. Motion Failure 66?	MOTION FAILURE - 66	Step 7
7. Is gear for pot R2 damaged?	Replace gear and recalibrate longitudinal motion	Step 7
8. Does limit switch S12 operate correctly?	Step 9	Troubleshoot S12 and correct problem.
9. Is limit switch S6 or S7 tripped (Motion Failure 72)?	MOTION FAILURE 72	Step 10

Question	Yes	No
10. Is pot R2 within valid range?	Step 12	Step 11
11. Is gear for pot R2 damaged?	Replace gear and recalibrate longitudinal motion	Step 12
12. Motor M2 problems (Error 55)?	MOTION FAILURE - 55	Step 13
13. Motor M2 problems (Error 67)?	CALL SERVICE -67	Step 14.
14. Problem Solved?	End	Call Technical Support

FILM FAILURE - 36

This means that the Motron CPU PCB didn't detect limit switch S12 opening at all, or opening when it should. Possible causes of this problem include:

1. **The Image Chain center position needs to be calibrated** so that S12's actuator is at the very top of the mechanical actuator cam when Image Chain movement ceases. You many need to remove the Splash and Crash cover to get a clear look at this switch and adjustment. Refer to Table Digital PCB Schematic 885026 for more information on this circuit.

CAUTION: Be careful when adjusting switch S12 in the following step. You can damage the switch by bending it up so high that it breaks when it collides with the cam.

2. **The mechanical actuator for S12 may need to be adjusted** so that S12 opens fully when the cam contacts S12's actuator. Enter table calibration mode for the X-ray system and use memory position buttons 1 or 3 to drive the film tray to the foot of the Table. Then move the Image Chain to open switch S12. Loosen the screws that secure either the switch or the actuator cam and reposition the switch or cam as necessary. After you adjust the switch or cam, slowly drive the Image Chain off the switch and slowly back on. Test S12 for proper operation.
3. **Bad connection on the Table Digital PCB**. WITH THE POWER OFF, measure the resistance between connector X3 pins 1 and 6 when S12 is closed. You should see a very low resistance through the wiring and the switch, but not a dead short. Repair or replace any defective parts you find. Refer to Table Digital PCB Schematic 885026 for more information on this part of the circuit.
4. **Bad connection on the Motron CPU PCB**. WITH THE POWER OFF, check the resistance between connector X11 pins 1 and 25. Remove connector from X11 to do this. Again you should see a very low resistance but not a dead short when S12's actuator is not on the cam and S12 is closed. Refer to Motron CPU PCB Schematic 884216 page 6 for more information on this part of the circuit.
5. **Bad optoisolator IC17 on the Motron CPU PCB**. Power up the system and allow it to boot. Connect your DVM across IC17 pins 13 (gnd) and 14. When S12 is closed, pin 14 should be at digital ground (150 mV or less). When S12 is open, pin 14 should be at +5 VDC. If you get different results, the Motron CPU PCB is most likely bad and needs to be replaced. Refer to Motron CPU PCB Schematic 884216 page 6 for more information on this circuitry.

MOTION FAILURE - 55

This message indicates a possible failure of Relay K2 on the Relay PCB.

1. **Check the +24 VDC power on the Relay PCB**. Use connector X8 pins 1 and 2 (pin 1 is ground). Verify also that LED 6 lights to indicate the presence of +24 VDC. This circuitry appears on sheet 1 of Relay PCB Schematic 884219.
2. **Check Motron CPU PCB Connector X9 on the Relay PCB**. You can remove the cable from the Relay PCB to to test this output signal. X9 pin 4 on the Relay PCB indicates the status of Relay K2. +24 VDC on this pin indicates that K2 is closed (energized). Pin 4 should have no voltage on it when K2 is open. Voltage on X9-4 when K2 is not energized means K2 is stuck shut. Replace the Relay PCB when this error occurs. This circuitry appears on sheet 1 of Relay PCB Schematic 884219.
3. **Check optoisolator IC13 on the Motron CPU PCB**. Power up the system and allow it to boot. Connect your DVM across IC13 pins 13 (gnd) and 14. When K2 is closed, pin 14 should be at digital ground (150 mV or less). When K2 is open, pin 14 should be at 5 VDC. If you get different results, the Motron CPU PCB is most likely bad and needs to be replaced. Refer to Motron CPU PCB Schematic 884216 page 3 for more information on this circuitry.

TABLE COMMUNICATIONS FAILED / CALL SERVICE - 61

This message indicates that the +5 VDC or the Vref voltage to the Motron CPU PCB's analog-to-digital converter is bad.

1. **Check LED D30 on the Motron CPU PCB**. This LED monitors the input to the analog +5 VDC supply. If this LED is off, check fuse F2 on the Motron CPU PCB. This circuitry appears on sheet 11 of Motron CPU PCB schematic 884216.
2. **Remove plugs from connectors X13 and X14 on the Motron CPU PCB**. This disconnects all position potentiometers from the analog +5 VDC supply. Check the disconnected plugs to determine if either of them is loading down the +5 VDC supply. Correct any short or replace any defective component you may find.
3. **Check the voltage on connector X14 of the Motron CPU PCB**. Use pin 3 or 6 as the ground reference. Use pin 1 or 4 as the analog +5 VDC. If +5 VDC is not present, replace the Motron CPU PCB. This circuitry appears on sheet 8 of Motron CPU PCB schematic 884216.
4. **Check the voltage reference to the CPU analog-to-digital converter on the Motron CPU PCB**. Use pin 3 or 6 on connector X14 as ground. Check the voltage on each side of resistor R67, which is near X14. One side should be at about +9 VDC and the other side should be at about +4.99 VDC. If no voltages or wrong voltages appear across R67, replace the Motron CPU PCB. This circuitry appears on sheet 11 of Motron CPU PCB schematic 884216.

MOTION FAILURE - 66

This is a general motion failure that occurs when the Motron CPU PCB senses that potentiometer R2 does not move. The actual cause of the failure may be a broken gear wheel on R2, no power to R2, no power to motor M2, mechanical blockage of the movement, or mechanical binding during the movement. Troubleshoot potentiometer R2 problems as follows:

1. Turn on the system power and let the table boot fully.
2. Remove the top cover from the tower. Connect your laptop to the serial port and enter the service mode.
3. Start the Utility Suite software and select the Motron tool.
4. Open the oec_new.hpp file and select the Read CPU button.
5. Select the Monitor button. This opens up a new window.
6. Select option two. This opens the Analog Test window. Check the M2 line. If the value is between 25 and 1000, R2 is probably OK. If the value is outside this range, the Table software does not allow X-ray arm motion and generates the MOTION FAILURE - 66 error. Possible causes of this error include broken R2 gear, bad R2, analog 5 VDC or analog ground bad or missing.

   Troubleshoot pot R2 as follows:

   a. **Remove the stainless steel cover that is near the tower to get access to** R2. Move the Table top laterally from the tower to gain access to the pot.
   b. **WITHOUT TURNING ITS SHAFT, Make a note of the current value of R2 in the Analog Test window**. Write down this information so you can use it in step e, below.
   c. **Disengage pot gear from gear track by pushing pot against the engagement spring**. Note that pot gear pivots away from gear track. Carefully inspect pot gear for cracks and other damage.
   d. While looking at the Analog Test window, spin the pot gear by hand and see if the pot's value in the Analog Test window changes.
   e. **Rotate pot back to value you observed in step b**. Release pot so its gear re-engages in gear track.
   f. **Check pot R2's connections on** connector X13 on the Motron CPU PCB. Pot R2 connects to pins 7, 8, and 15, with pin 15 being the wiper. You can see this circuitry on sheet 8 of Motron CPU PCB Schematic 884216.

g. **Disconnect plug from X13 and check pot R2's resistance across pins 7 and 8 on the plug.** You should read 10k ohms between pins 7 and 8.

h. **Re-connect plug to X13 and check analog voltage on X13.** You should measure +5 VDC between pins 7 and 8 on the connector. Pin 8 is analog ground. Make sure LED D30 is lit. This LED monitors the voltage to the CPU's analog-to-digital converter. You can see this circuitry on sheet 8 of Motron CPU PCB Schematic 884216.

7. **Check motor power on** connector X2A of the Relay PCB. First, make sure all wires on X2A are fully inserted. Then measure the voltage between each of the phases while the motor is running. Check between pins 1 and 2, between pins 1 and 3, and between pins 2 and 3. All voltages should be the same. Refer to sheet 1 of Relay PCB Schematic 884219 to see this circuitry.

8. **Check the resistance of the safety loop on connector X2B of the Relay PCB.** The resistance between pins 3 and 4 should be 0.7 ohms. Motor thermal protector T4 is normally closed and open when the motor is overheated. Limit switches S6 and S7 are normally closed and open when engaged by the mechanical stops. Refer to Schematic 885024 for a diagram of M2, and to Schematic 885018 for a wiring diagram of the Relay PCB.

9. **Check Motor M2 connector X2.** Connector X2 is the large covered connector near Motor M2. FIRST, POWER DOWN THE SYSTEM. Remove connector X2 by flipping the locking lever and pulling the connectors apart. Next, inspect the connector to make sure there are no loose pins. Note that the pins are arranged in rows 1 through 5 and columns A, B, and C. Perform resistance checks shown in the following table. You can perform the same tests on Relay PCB connectors X4A and X4B. Refer to Schematic 885024 for a diagram of M2, and to schematic 885018 for details on of the Relay PCB.

Connections to Check on X2

Function	Pin Pair on X2	Resistance
Motor Coil	A1-B1	26Ω
Motor Coil	A1-C1	26Ω
Motor Coil	B1-C1	26Ω
Jumper	A5-B5	0.1Ω
Limit Switch S6 and S7	A5-B4 (female)	0.4Ω

Function	Pin Pair on X2	Resistance
Limit Swtich S6 and S7	A5-B4 (male)	open
Thermal Switch T2	A4-B4	0.1Ω
Chassis Ground	C5-Chassis	0.1Ω

10. **Make sure drive screw operates freely.** Inspect entire mechanism to make sure rails, rollers, and bearings all operate without binding.
11. **Check** Fuse F2, which is located on the side of the Table Power Supply. This 4-amp or 5-amp fuse is the current-limiting device for Frequency Inverter U1. Refer to Table Power Supply Wiring Diagram 885025 for more information.

CALL SERVICE - 67

This message is an indication of a stuck brake relay on Frequency Inverter U1.

1. **Check Frequency Inverter U1**. WITH THE POWER OFF, connect an ohmmeter to Relay PCB connector X6 pins 8 and 9, which connect to a normally-open relay contact on U1. U1 closes this contact when it wants to release the brake to run M2. This relay contact should otherwise remain open. If you see a short between pins 8 and 9 with the power off, it means the brake relay is stuck shut, and you need to replace Frequency Inverter U1. Refer to sheet 1 of Relay PCB Schematic 884219 and to Table Block Diagram 885015 for more information.
2. **Check connector X9 on the Relay PCB**. X9 pin 12 (X6 pin 8 is easier to probe) indicates the status of the brake relay on Frequency Inverter U1. +24 VDC on pin 12 indicates the relay is closed, and 0 Volts on pin 12 indicates the relay is open. The brake relay in Frequency Inverter U1 should be open unless M2 or M1 is running. If +24 VDC is present on X9 pin 12 when neither M2 nor M1 is running, look for a short between traces on the Relay PCB. If Frequency Inverter U1's brake relay appears to be stuck shut, replace Frequency Inverter U1. Refer to sheet 1 of Relay PCB Schematic 884219 for more information on this circuitry.
3. **Verify that the Brake relay status signal is present on Motron CPU PCB ribbon cable connector** X5. Probe pin 12 using X1 pin 4 as the reference. IC20 pin 3 should have +24 VDC on it when M2 or M1 runs. If +24 VDC is not present, look for a faulty or loose cable running between X5 on the Motron CPU PCB and X9 on the Relay PCB. Make sure the cable is fully seated in both connectors. Refer to sheet 3 of Motron CPU PCB Schematic 884216 to view this circuitry.
4. **Verify that optoisolator IC20 on the Motron CPU PCB works**. A ribbon cable connects X5 on the Motron CPU PCB to X9 on the Relay PCB. When M2 runs, the brake relay on Frequency Inverter U1 closes, and +24 VDC appears on pin 12 of X5. This power also appears on pin 3 of IC20, lighting the internal LED and turning on the associated junction between pins 13 and 14. This supplies a ground to the I/O and latch circuitry shown on schematic sheet 2, which in turn notifies the processor that M2's brake is on. Use your DVM to probe IC20 pin 14, using pin2 or the heat tab on IC12 (the 7805 5 VDC regulator) as ground. Pin 14 should be near digital ground (150 mV) when the brake relay is closed, and at +5 VDC when the relay is open. If pin 14 does not operate correctly, replace the Motron CPU PCB. Refer to
sheet 3 of Motron CPU PCB Schematic 884216 to view this circuitry.

MOTION FAILURE - 72

Mechanical limit switches S6 and S7 are in the same series loop with Motor M2's thermal switch T2 and the interlock contact in Relay K1. This message is usually associated with the failure of a limit switch or the thermal switch. Follow these steps to troubleshoot the failure:

1. **POWER DOWN THE SYSTEM. Then check the resistance between pins 3 and 4 on Relay PCB connector** X2B. If the loop is open, S6, S7, or T2 or the associated wiring has an open somewhere. Inspect each component and look for loose or damaged wiring. If the loop is closed as it should be, go to step 9 below. Refer to sheet 1 of Relay PCB Schematic 884219 and to Motor M2 Wiring Diagram 884024 to see this circuitry.
2. **Check the emergency stop +24 VDC power on the Relay PCB**. You can measure this voltage on Relay PCB connector X9 pin 11. Use pin 15 or 16 on connector X9 or the feed-trough on the left side of X9 for ground. (Refer to sheet 1 of Relay PCB Schematic 884219 to see this circuitry.) If +24 VDC is present, go to step 3. If +24 VDC is not present, it is possible that one of the Emergency Stop buttons is engaged. If both Emergency Stop buttons are OK physically and electrically, check for emergency stop NOTAUS as described next.
3. **Measure the NOTAUS +24 VDC on Relay PCB connector** X9 **pin 13**. Use pin 15 or 16 on connector X9 or the feed through on the left side of X9 for ground. Make sure that LED V3 on the Table Digital PCB lights to indicate that emergency stop +24 VDC is present. Refer to sheet 1 of Relay PCB Schematic 884219 to see this circuitry.
4. **Check the +24 VDC on the Relay PCB**. Measure this voltage on connector X8 pins 1 and 2. LED 6 should be lit. Use pin 1 as ground. Refer to sheet 1 of Relay PCB Schematic 884219 to see this circuitry.
5. **Check limit switches S6 and S7**. The actuator for either switch MUST NOT be in contact with its aluminum actuator bar. If either switch's actuator currently rides on a bar, use manual override pushbutton T2 on the Relay PCB along with the proper key control to drive the Image Chain back into "legal" range. Then check Table calibration and make adjustments as necessary. Refer to sheet 1 of Relay PCB Schematic 884219 and to Relay PCB Wiring Diagram 885018 to see this circuitry.
6. **Isolate switches S6 and S7 at motor connector** X2. TURN OFF SYSTEM. If you haven't done so already, remove panel to gain access to M2 and X2. Disconnect wiring from X2 and use an ohmmeter along with this table to determine which switch is open or shorted. Refer to Motor M2 Wiring Diagram 885024 and to Relay PCB Wiring Diagram 885018 to see this circuitry.
7. **Verify correct operation of limit switches** S6 and S7. Actuate each switch and check connections. Repair wiring or replace switches as necessary.

8. **Check thermal switch T2**. If T2 is open, verify that motor M2 is actually hot. If motor is hot, check Image Chain for blockage or mechanical binding. Check motor coils for opens or shorts. Replace motor if you find it defective. Refer to Motor M2 Wiring Diagram 885024 and to Relay PCB Wiring Diagram 885018 to see this circuitry.
9. **Check for a closed loop between** Relay PCB connector X2B**, pin 4 and the cathode side of D2**. An open loop here is an indication that K1.2 is not closed as it should be. Refer to sheet 1 of Relay PCB Schematic 884219 to see this circuitry. Replace the Relay PCB if this circuitry is defective.
10. **Check the cable that connects** X5 **on the Motron CPU PCB and** X9 **on the Relay PCB**. Be sure to check pins 3, 4, 11, 14, 15 and 16. Look for damaged or loose connectors. You can see this circuitry on sheet 3 of Motron CPU PCB Schematic 884216 and on sheet 1 of Relay Schematic 884219.
11. **Check Interlock Relay K2**. POWER DOWN THE TABLE. Connect an ohmmeter between X8 pin 2 on the Relay PCB and the cathode of flyback diode D2 on Relay K2. The ohmmeter should show an open circuit. Pressing switch T2 should cause a short in the same circuit. If a short does not occur when you press T2, the Relay PCB is bad and you should replace it. Refer to sheet 1 of Relay PCB Schematic 884219 to see this circuitry.
12. **Check coil resistance of Relay K2**. Place an ohmmeter across flyback diode D2 on the Relay PCB. If you get a low resistance, the meter has probably forward biased D2. Reverse the meter leads and try again. When D2 is not forward biased, you should see a resistance of about 183 ohms through the relay coil. If you see an open circuit, the coil on K2 is open, and you must replace the Relay PCB. Refer to sheet 1 of Relay PCB Schematic 884219 to see this circuitry.
13. **Check motor M2 control signal at K2 on Relay PCB**. Connect the negative lead of your DVM to X8 pin 1 on the Relay PCB, which is the +24 VDC ground. Then probe X9 pin 3 (on top of R4 near T2). When Motor M2 runs, pin 3 should be close to +24 VDC. When Motor M2 is off, pin 3 should be at +24 VDC ground. If you see a signal on pin 3 when M2 is off, Darlington transistor Q2 is probably bad. Replace the Relay PCB. Refer to sheet 1 of Relay PCB Schematic 884219 to see this circuitry.
14. **Check motor M2 control signal on Motron CPU PCB**. Connect the negative lead of your DVM to X1 pin 4 on the Motron CPU PCB. Then probe X5 pin 3 (IC11 pin 13), which should be at +24 VDC when M2 runs and at the +24 VDC ground when M2 is off. Replace the Motron CPU PCB if the motor control signal is not present. Refer to sheets 3 and 11 of Motron CPU PCB Schematic 884216 to see this circuitry.
15. **Check connector** X9 **on the Relay PCB**. X9 pin 4 indicates the status of Relay K2. (Use X8 pin 1 as the ground.) You can remove the cable to measure the output of the Relay PCB. When K2 is energized, pin 4 should have +24 VDC on it. When K2 is not energized, there should be no voltage on pin 4. If +24 VDC is present when the relay is not energized, K2 is

probably stuck shut. Replace the Relay PCB to correct this problem. Refer to sheet 1 of Relay PCB Schematic 884219 to see this circuitry.

16. **Check optoisolator IC11 on the Motron CPU PCB**. Using pin 2 or the heat tab of the 7805 +5 VDC regulator IC12, check the voltage on IC11 pin 14. When motor M2 runs, the voltage should be close to digital ground (150 mV). When M2 is off, the voltage on pin 14 should be close to +5 Volts. If you get significantly different results, replace the Motron CPU PCB. Refer to sheets 3 and 11 of Motron CPU PCB Schematic 884216 to see this circuitry.

MOTION FAILURE - 101

This message indicates that 4-amp fuse F2 that supplies current to Frequency Inverter U1 is open. This fuse appears in Power Supply Wiring Diagram 885025.

Film Cassette Longitudinal Movement (M5)

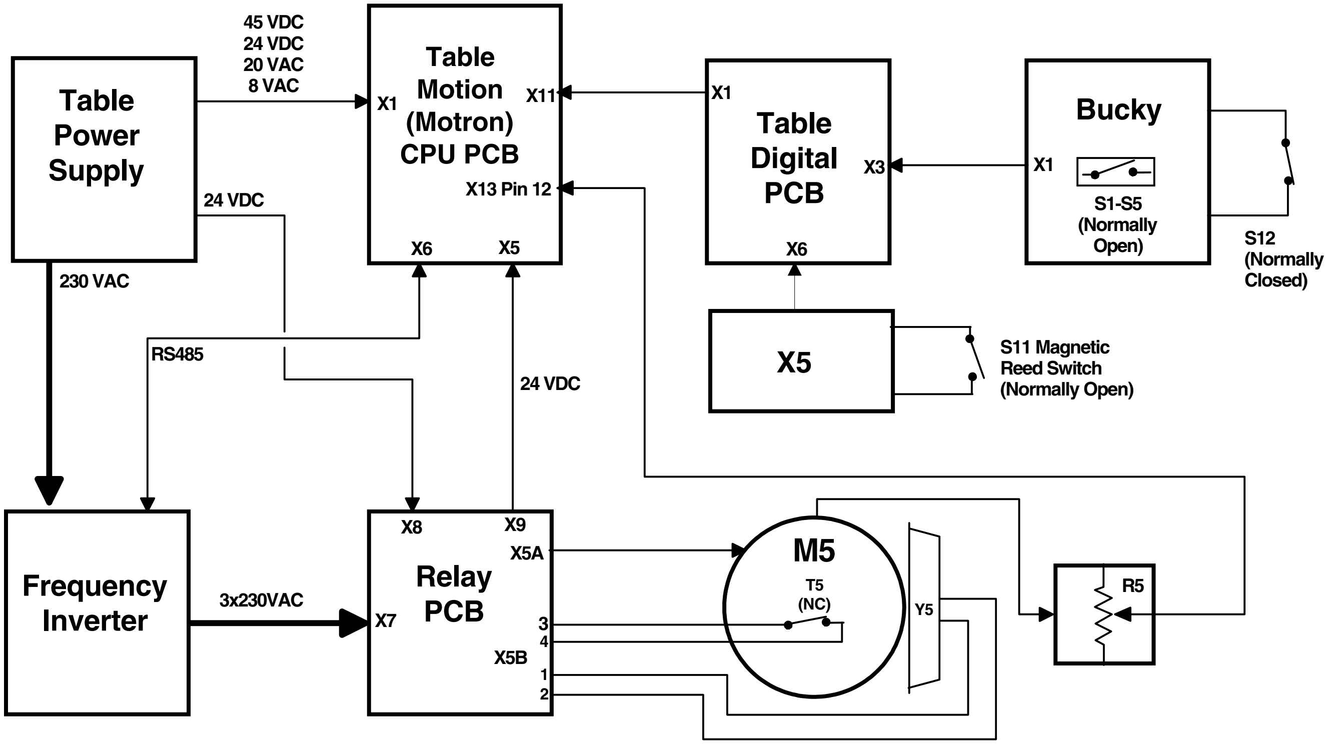
The following paragraphs describe the circuitry that performs longitudinal (head-to-foot and foot-to-head) movement of the Cassette Tray (also called the "Bucky") and Film Cassette by Motor M5.

Overview

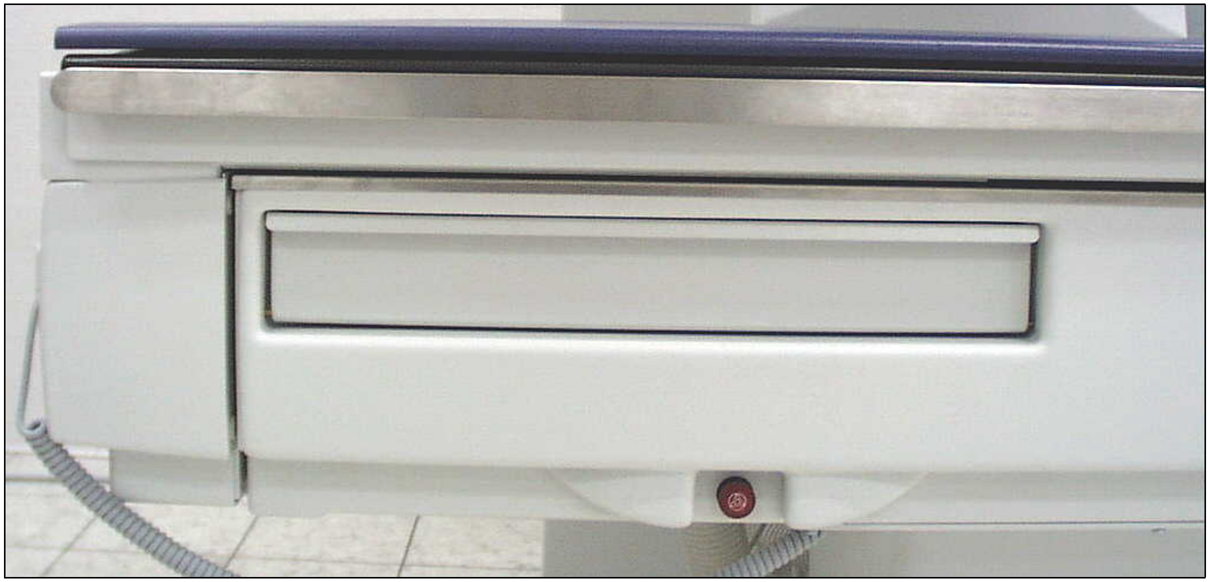
After you load a film cassette and press the FILM button, the Cassette Tray moves the film cassette from its loading position behind the film slot to a position centered over the Image Intensifier and under the X-ray tube, where the X-ray beam can expose the film on command. After exposure, the film cassette moves back behind the film slot, allowing the operator to retrieve the cassette and process the exposed film in the cassette.

WARNING! *Cassette Tray movement is powerful, fast, and dangerous. Stay clear of Cassette Tray at all times when servicing the Table with the Cassette Tray exposed and power applied to the Table. Turn off all power when working on Cassette Tray components or other components nearby. Failure to heed this warning may result in serious personal injury or equipment damage.*

The following block diagram shows the components that perform Cassette Tray longitudinal movement.


45 VDC
24 VDC
20 VAC
8 VAC
Table Power Supply
24 VDC
230 VAC
Table Motion (Motron) CPU PCB
X1
X11
X13 Pin 12
X6
X5
X1
Table Digital PCB
X3
X6
Bucky
X1
S1-S5 (Normally Open)
S12 (Normally Closed)
X5
S11 Magnetic Reed Switch (Normally Open)
RS485
24 VDC
Frequency Inverter
3x230VAC
X7
X8
X9
X5A
Relay PCB
3
4
X5B
1
2
M5
T5 (NC)
Y5
R5

Motor M5 Film Transport Circuitry

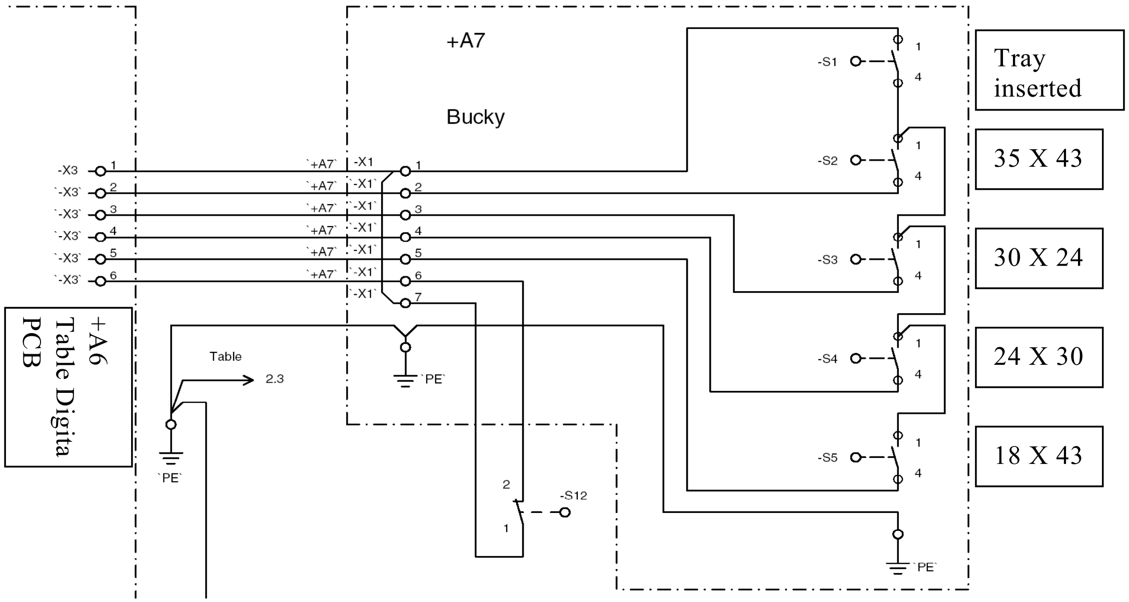


Film Cassette Slot and Door

Cassette Size and Position Detection

When you first press the FILM button, the Table Motion (Motron) CPU PCB checks the status of switches S1 through S5 in the Cassette Tray, which is the holder for the film cassette, and the status of switch S11, which detects when the door to the film slot is fully closed. S1 through S5 are normally open, and S11 is a magnetic reed switch that is normally open unless the Film Cassette Slot door is closed. A magnet on the Film Cassette door closes S11.

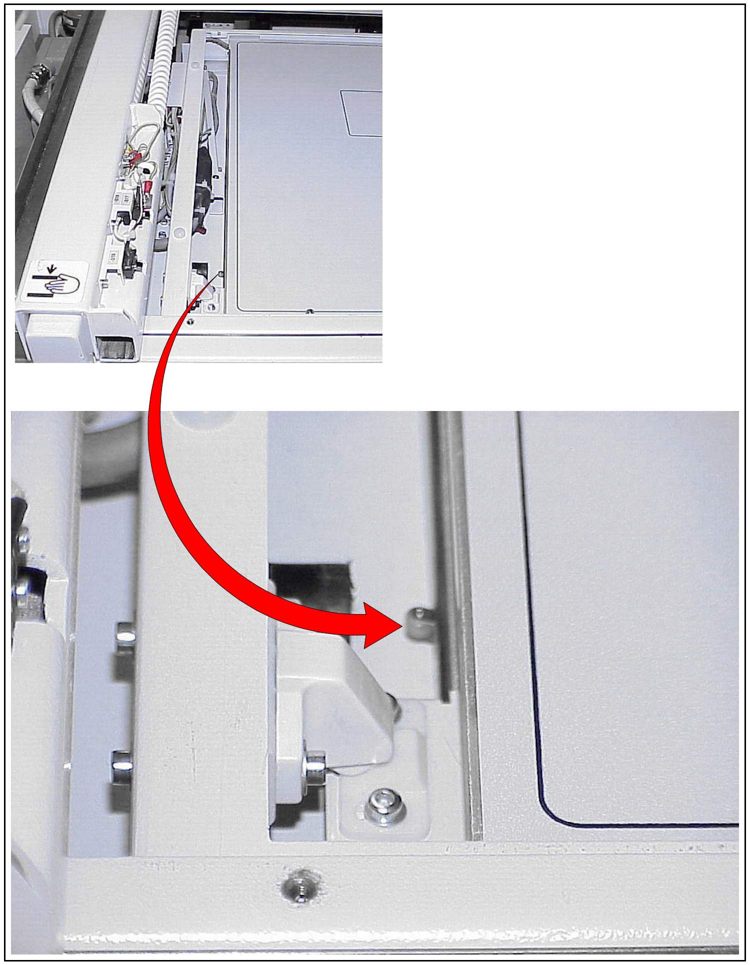
When you fully insert the film cassette into the Cassette Tray, S1 on the Cassette Tray closes, supplying power to one side of S2 through S5, as shown in the following diagram.


+A7
Bucky
-X3
`-X3`
1
2
3
4
5
6
`+A7`
-X1
`-X1`
7
+A6
Table Digita
PCB
Table
2.3
`PE`
-S1
-S2
-S3
-S4
-S5
-S12
Tray
inserted
35 X 43
30 X 24
24 X 30
18 X 43

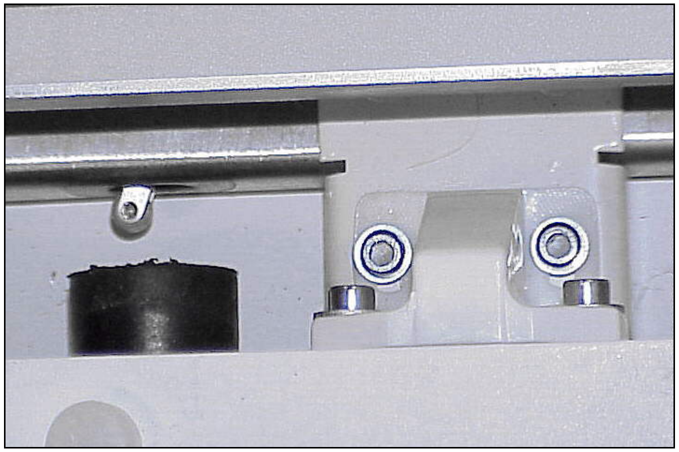
Cassette Tray Sensing Switches

The Cassette Tray locking mechanism closes only one of these switches, providing positive indication of film size back to the Motron PCB. When the Motron sees that the cassette is in position ready for filming and it knows what size the cassette is, it moves the cassette from behind the Film Slot to a spot centered over the Image Intensifier and under the X-ray tube. The X-ray Arm also moves into position, ready to expose the film. When the cassette is in place, it closes normally-open switch S12, letting the Motron PCB know that the cassette is in position ready for an X-ray.

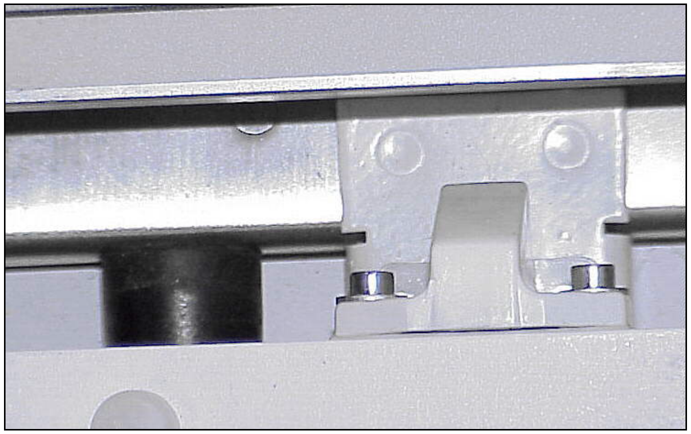
Switch S1 resides on the Cassette Tray, as shown in the following picture. The Cassette Tray's mechanical latch must engage before S1 closes.



Switch S1 Location



Mechanical Latch Not Engaged - S1 Open



Mechanical Latch Engaged - S1 Closed

The following table summarizes the purpose of cassette-sensing switches S1 through S5, and switch S12:

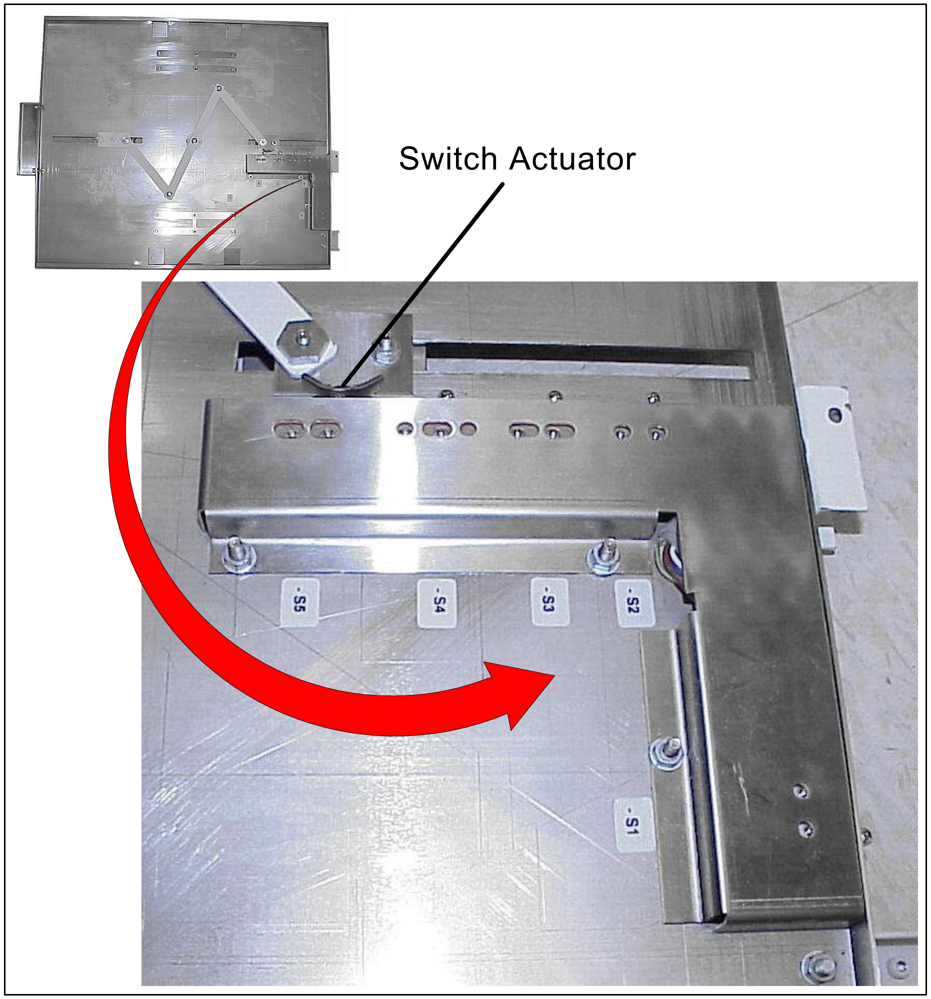
Cassette-Sensing Switch Summary

Switch	Function	Table Digital PCB Connector - pin
S1	Film Tray Inserted Fully	S1 in series with S2 – S5
	24 VDC	X3-1
S2	Film Size 25 x 43	X3-2
S3	Film Size 30 x 24	X3-3
S4	Film Size 24 x 30	X3-4
S5	Film Size 18 x 43	X3-5
S12	Film Tray Position; opens when the cassette tray centers under the X-ray tube ready for exposure or when switch is activated	X3-6

Note: *S1 through S5 all reside on the Cassette Tray and are normally open; S12 resides on the chassis and is normally closed.*

Note: *The above Table gives film size in centimeters.*

The following picture shows switches S1 through S5 as they appear on the bottom of the Cassette Tray.


Switch Actuator
- S5
- S4
- S3
- S2
- S1

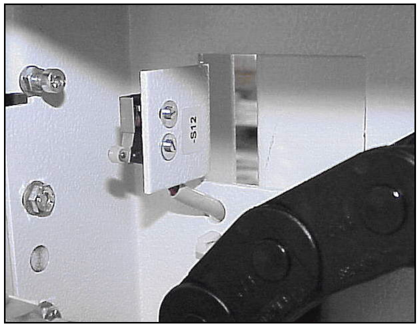
Film Cassette Tray Switches

Film Cassette Movement

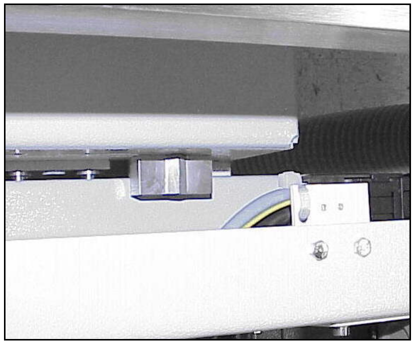
When you press the FILM button on the Collimator Control Panel or on the X-ray Control Panel, you must hold the FILM button down until the LED next to it stays lit, indicating the system is in Film mode. The LED won't light until the film chain moves to the calibrated center position and the Cassette Tray moves to the film position. The film chain motion can occur only while you keep the FILM button pressed because the Table Motion (Motron) CPU PCB won't start or maintain any movement without a key closure. Each key has two poles. One pole is a security line and the other pole causes the associated movement. Refer to the Table Key Controls section of this manual for more information on the security line.

Switch S12

Switch S12 is normally closed when the film cassette is parked behind the film slot. S12 opens when the Cassette Tray passes across a mechanical actuator cam on the image chain, signaling the Motron CPU that the film tray and the image chain are in position ready for a film shot.



Switch S12



Actuator Cam for S12

Relay PCB

Frequency Inverter U2 powers motors M3, M4, and M5, but only one motor at a time. The Motron CPU PCB selects the motor to power by actuating certain relays on the Relay PCB. Relay K3 connects Frequency Inverter U2 to Motor M3, Relay K4 connects Frequency Inverter U2 to Motor M4, and Relay K5 connects Frequency Inverter U2 to motor M5. Interconnections between relays K3 and K4 prevent power from being applied to more than one motor at the same time.

Communications

The Motron CPU PCB and Frequency Inverter U2 communicate over an RS-485 serial link. The Motron CPU PCB calls up stored control parameters to operate M5. Frequency Inverter U2 pulse-width modulates its single-phase input to produce three-phase power for M5. The Motron CPU PCB receives film tray position feedback information from potentiometer R5. The Motron CPU PCB does an analog-to-digital (A/D) conversion of the voltage on the pot's wiper. The software program uses this value to determine where the film tray is in relation to the table, and to determine if the film tray's position is within the calibrated limits specified in the .hpp file.

Switch S11

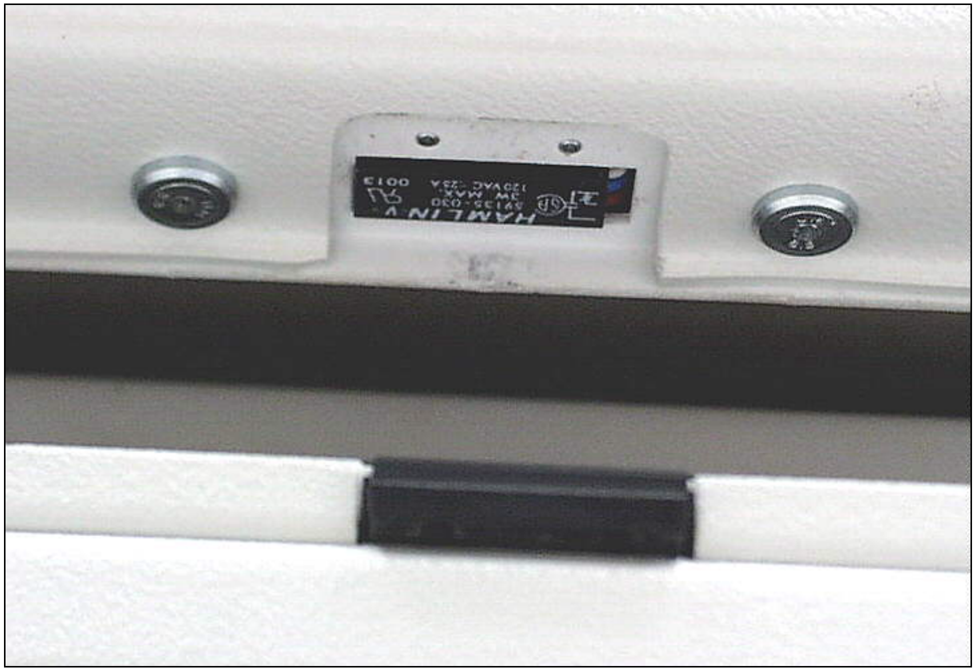
CAUTION: Be sure to turn off all power to the Table before testing Switch S11.

S11 is a normally open magnetic reed switch that monitors the position of the film cassette door. A magnet on the film cassette door closes the switch when the door is shut. You can monitor S11 for correct operation by checking for switch continuity while opening and closing the film cassette door and watching the circuit make and break between pins 1 and 2 on connector X6 on the Table Digital PCB.

S11 does not wire directly to X6 on the Table Digital PCB. Instead, the circuit goes through connector X5, which is described in the next paragraph. The following table provides connection details for S11.

Switch S11 Connectors

Switch S11 Connection	Function	Intermediate Connector	Table Digital PCB Connector Pin
White wire	Film Slot Door Monitoring	X5-1	X6-1
Red wire	Film Slot Door Monitoring	X5-2	X6-2



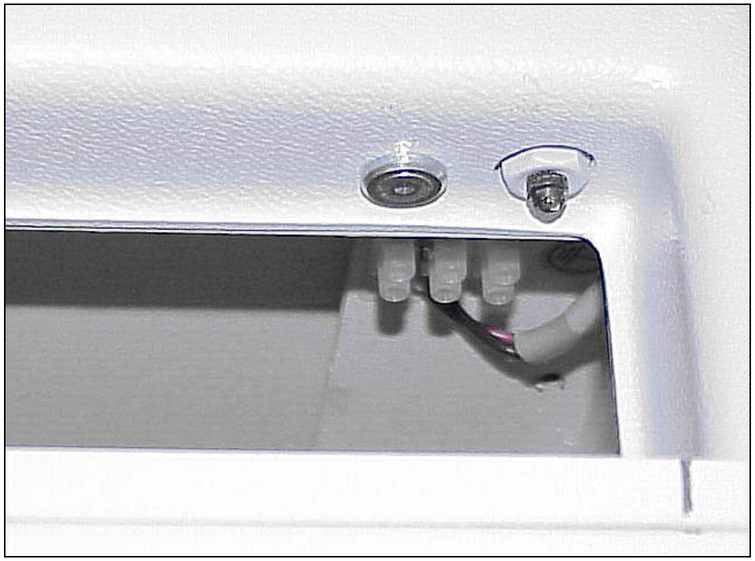
Switch S11 and Magnet on Film Cassette Door

Power Connectors

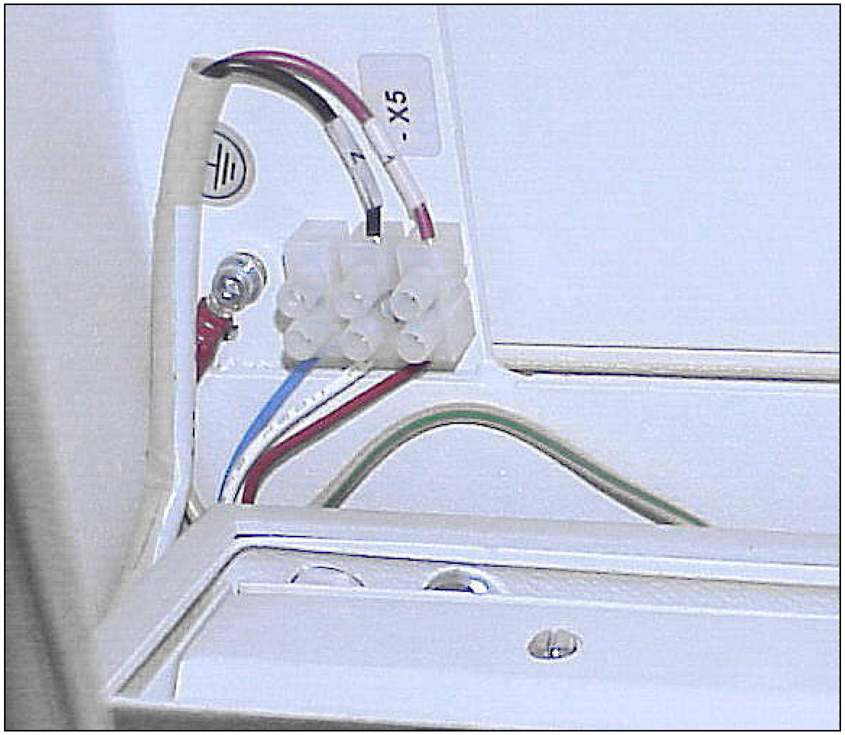
Note: The letter "A" in a connector reference designator (for example, X5A) identifies the connector as one that supplies three-phase power to a motor.

Note: The letter "B" in a connector reference designator (for example, X5B) identifies the connector as one that supplies 24 VDC power to a motor brake.

Three-phase power from Frequency Inverter U2 connects to Motor M5 through connector X5A on the Relay PCB. The following illustrations show connector X5 as it appears through the film slot and from inside the Table.



Connector X5 Seen Through the Film Slot



Connector X5 Seen From Bottom of Table

M5 Brake

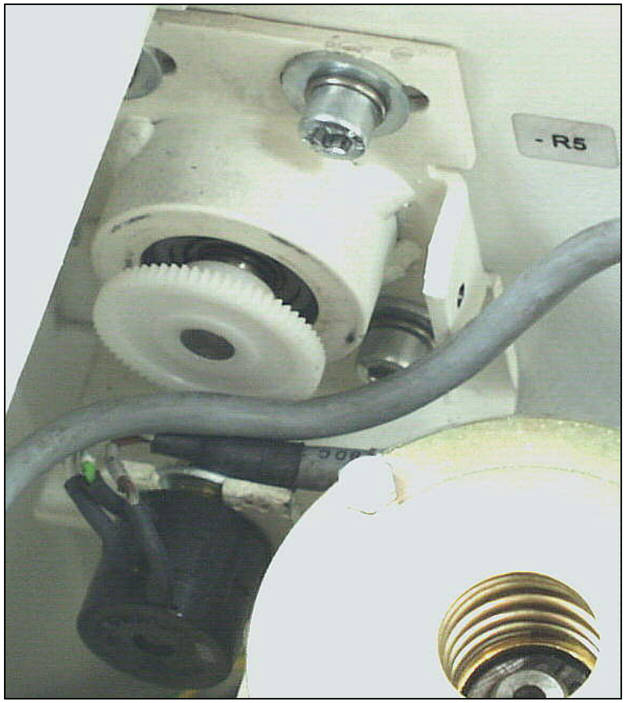
The brake for Motor M5 is internal to the motor, and operates on 24 VDC. The brake is normally engaged when no power is applied, preventing the motor from turning. When the Frequency Inverter applies three-phase power to M5, it also applies 24 VDC, which releases M5's brake.

M5 Safety

There are no safety switches for motor M5. There is a normally-closed thermal cutout device on the motor that opens to stop motor M5 should the motor overheat. The thermal cutout switch connects to X5B on the Relay PCB. The hot thermal cutout interrupts the 24 VDC supply to the brake, stopping the motor.

Potentiometer R5 Drive Mechanics

Motor M5 drives the Cassette Tray with a belt. A gear on the return pulley of this drive belt rotates multi-turn feedback potentiometer R5. This enables the Motron CPU PCB to get Cassette Tray information by reading the voltage on the pot's wiper. The following picture shows the gear on the return pulley meshing with the gear on the shaft of R5.



Potentiometer R5 and Pulley Drive Gear

Error Messages

Cassette Tray movement and related functional failures can generate the following error messages. Click the hyperlinked messages if you need troubleshooting assistance.

Cassette Tray Movement Error Messages

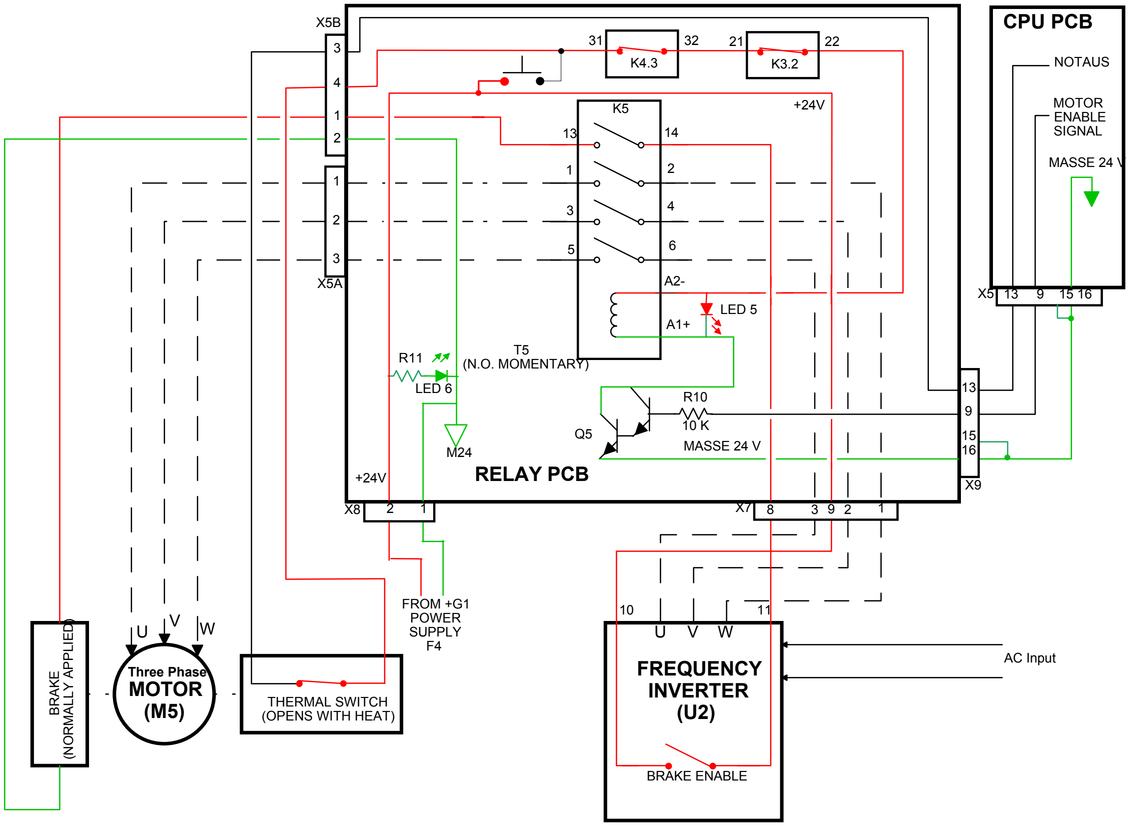
Error	Displayed Message	Logged Message	Code
Film door not closed during Film Request mode	*CASSETTE DOOR OPEN	None	32
Remove Cassette	*REMOVE CASSETTE	None	87
Release of Film Exposure Contact Closure prior to X-ray Assembly and Cassette reaching Film Exposure Position during Film Mode Request	None	TBL FILM MODE RELEASE EARLY	44
Film Size Error	CASSETTE NOT READY	None	57, 58
X-ray Assembly Arm not in X-ray Ready during X-ray Mode request	X-RAY ARM NOT READY (Line 1 of VFD) X-RAY BLOCKED (Line 2 of VFD)	X-RAY ARM NOT READY X-RAY ARM BLOCKED	33 82
X-ray Arm and Cassette not centered during Film Mode request	FILM FAILURE - 36	TBL IMAGE CHAIN NOT CENTERED	36
Motor M5 Problem -- Cassette/Film Transport	MOTION FAILURE - 52	TBL FILM TRANSPORT	52

Error	Displayed Message	Logged Message	Code
		MOTOR PROBLEM	
Film Transport Motion Block/Potentiometer Problem	MOTION FAILURE - 70	TBL FILM TRANSPORT MOTION FAILURE	70
Frequency Inverter 1 for Tilt/Vertical, Longitudinal, Cassette out of order	MOTION FAILURE - 102	TBL FREQ CONVERT 1 ERROR	102

*These are normal operator messages that do not refer to a troubleshooting.

Troubleshooting

The following functional block diagram shows the circuitry related to the Film Mode and Motor M5. Use this diagram plus the procedure that starts on the next page for troubleshooting:


X5B
3
4
1
2
1
2
3
X5A
31
K4.3
32
21
K3.2
22
K5
+24V
13
14
1
2
3
4
5
6
A2-
A1+
LED 5
R11
LED 6
T5
(N.O. MOMENTARY)
R10
10 K
Q5
MASSE 24 V
M24
+24V
RELAY PCB
X8
2
1
X7
8
3
9
2
1
CPU PCB
NOTAUS
MOTOR
ENABLE
SIGNAL
MASSE 24 V
X5
13
9
15
16
13
9
15
16
X9
FROM +G1
POWER
SUPPLY
F4
BRAKE
(NORMALLY APPLIED)
U
V
W
Three Phase
MOTOR
(M5)
THERMAL SWITCH
(OPENS WITH HEAT)
10
11
U
V
W
FREQUENCY
INVERTER
(U2)
BRAKE ENABLE
AC Input

Motor M5 Control Circuitry

M5 Problems

Question	Yes	No
1. Do motors M3 and M4 both work?	Step 2	Motion Failure Error Code 102
2. Analog Voltage Error Code 61?	Analog Voltage Error Code 61	Step 3
3. Does filmer move easily by hand?	Replace Broken Belt	Step 4
4. Does filmer move but won't stay?	Step 9	Step 5
5. X-ray Arm Not Ready (Error Code 33)?	X-ray Arm Not Ready	Step 6
6. Cassette Door closed (Error Code 32)?	Check Switch S11	Step 7
7. Film Size Error (Error Code 57 or 58)?	Cassette Not Ready	Step 8
8. Pot R5 Between 25 and 1000	M5 Motor Problems; Error Code 52	Pot Failure; Error Code 70
9. Problem Solved?	Call Technical Support	Step 10
10. Are you holding the FILM button long enough?	Step 11	Error Code 44; hold Film button until LED comes on.
11. Are Image Chain, Cassette Alignment, and Calibration OK?	Step 12	Check Switch S12
12. Does pot R5 have a cracked gear?	Replace Gear and Recalibrate motions	Step 13
13. Problem solved?	End	Call Technical Support

CASSETTE DOOR OPEN

This message appears when the Motron CPU PCB determines that switch S11 on the Film Slot door is not closed. First make sure the Film Slot door is completely closed.

REMOVE CASSETTE

This message appears on the VFD as a reminder to the operator to remove the film cassette after a radiographic shot. This is an information message only, which the system does not log in any error file.

TABLE FILM MODE RELEASE EARLY (Logged Message)

You will see this message in a log file when the operator does not hold the FILM button long enough to put the system in Film mode. Make sure the system operator understands that the FILM button must be held down until the LED stays lit. Refer to Film Cassette Movement for more information.

CASSETTE NOT READY

This message is an indication that a film cassette is not present in the film tray, or that the cassette inserted is not a valid size. If a valid cassette is loaded and properly locked into the tray, this message is an indication of a switch activation or connectivity problem.

System Cannot Detect Any Film Sizes

1. **Check for +24 VDC on the Motron CPU board**. Check Connector X1 pins 1 and 4, using pin 4 as ground. Make sure that LED D31 is lit.
2. **Check for +24 VDC on the Table Digital PCB**. Check X3 pin 1, using X3 pin 13 as ground. LED V2 and LED V3 on the Table Digital PCB provide visual indication that +24 VDC is present.

CAUTION: Turn off system power before starting next step.

3. **Test switch S1**. This switch must close when you put the film cassette into the Table, or S2 through S5 in the Cassette Tray won't work. (See schematic.) Turn power off. Position the tray locking mechanism over each switch (S2 though S5), slide the Film Cassette into the Tray, and check the resistance between pin pairs on X3 on the Table Digital PCB. Use the following table for pin information:

Switch	X3 Pin Pair
S2	1 and 2
S3	1 and 3
S4	1 and 4
S5	1 and 5

   If any switch works, S1 is working. If no switch works, S1 is not making contact or has a faulty connection. Investigate and repair.

4. **Check the film size actuator.** Remove any Film Cassette and extend the Film Cassette Tray out of the Table. While looking at the bottom of the Cassette Tray, move the Film Cassette locking mechanism back and forth. The actuator should contact switches S2 through S5 one at a time, closing each switch as it passes over. You should be able to hear each switch click as it closes. If the actuator doesn't close each switch, investigate the cause and carefully make any adjustments necessary.

CAUTION. *Be very careful as you adjust the Film Cassette Tray. Replacing a broken Cassette Tray is not a trivial task.*

One Film Size Not Detected

This procedure allows you to test switches S2 through S5 individually.

CAUTION. *Turn off system power before proceeding.*

Note: You don't need a Film Cassette to test the Cassette Tray switches. Just move Film Cassette locking mechanism until it closes the appropriate switch, and then lock the mechanism in place.

1. **35mm x 43mm, S1 to S2 check**. Extend the Cassette Tray from the Table and move the cassette locking mechanism to the 35mm x 43mm (longest) position. Lock the mechanism into place, and push the Cassette Tray back into the Table. Use an ohmmeter to check for a short, which should be present between X3 pin 1 and X3 pin 2 on the Table Digital PCB.
    - a. If there is no short, make sure the actuator is engaging the switch. If necessary, adjust the actuator.
    - b. If the actuator is engaging the switch, check the wiring and connections. Access the bottom of the Cassette Tray to replace a faulty switch. Refer to the Replacement chapter for details.
    - c. If there is a short, check the connection on the Motron CPU PCB. You can test this film size on X11 pins 1 and 18. Use an ohmmeter to check the resistance of the cable.
    - d. Power up the system and check the optoisolator IC16 on the Motron CPU PCB. The film size lines are optically isolated from the Motron PCB. Check IC16 pin 12. This pin will be near digital ground (150mV) when activated, or at +5 VDC when not activated. Replace the Motron CPU PCB if this circuit is not working.

CAUTION Power down the system after you complete this step.

2. **30mm x 24mm, S1 to S3 check**. Extend the Cassette Tray from the Table and move the cassette locking mechanism to the 30mm x 24mm (next to longest) position. Lock the mechanism into place, and push the Cassette Tray back into the Table. Use an ohmmeter to check for a short, which should be present between X3 pin 1 and X3 pin 3 on the Table Digital PCB.
    - a. If there is no short, make sure the actuator is engaging the switch. If necessary, adjust the actuator.
    - b. If the actuator is engaging the switch, check the wiring and connections. Access the bottom of the Cassette Tray to replace a faulty switch.
    - c. If there is a short, check the connection on the Motron CPU PCB. You can test this film size on X11 pins and 17. Use an ohmmeter to check the resistance of the cable.
    - d. Power up the system and check the optoisolator IC16 on the Motron CPU PCB. The film size lines are optically isolated from the Motron PCB. Check IC16 pin 10. This pin will be near digital ground (150mV) when activated, or at +5 VDC when not activated. Replace the Motron CPU PCB if this circuit is not working.

CAUTION Power down the system after you complete this step.

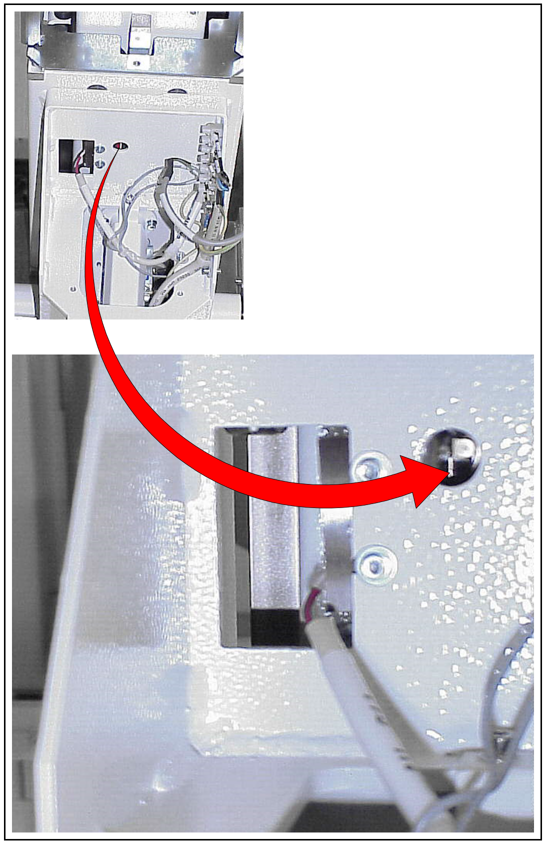
3. 24**mm x 30mm, S1 to S4 check**. Extend the Cassette Tray from the Table and move the cassette locking mechanism to the 24mm x 30mm (next to shortest) position. Lock the mechanism into place, and push the Cassette Tray back into the Table. Use an ohmmeter to check for a short, which should be present between X3 pin 1 and X3 pin 4 on the Table Digital PCB.
   a. If there is no short, make sure the actuator is engaging the switch. If necessary, adjust the actuator.
   b. If the actuator is engaging the switch, check the wiring and connections. Access the bottom of the Cassette Tray to replace a faulty switch.
   c. If there is a short, check the connection on the Motron CPU PCB. You can test this film size on X11 pins and 19. Use an ohmmeter to check the resistance of the cable.
   d. Power up the system and check the optoisolator IC16 on the Motron CPU PCB. The film size lines are optically isolated from the Motron PCB. Check IC16 pin 14. This pin will be near digital ground (150mV) when activated, or at +5 VDC when not activated. Replace the Motron CPU PCB if this circuit is not working.

CAUTION Power down the system after you complete this step.

4. 18**mm x 43mm, S1 to S5 check**. Extend the Cassette Tray from the Table and move the cassette locking mechanism to the 18mm x 43mm (shortest) position. Lock the mechanism into place, and push the Cassette Tray back into the Table. Use an ohmmeter to check for a short, which should be present between X3 pin 1 and X3 pin 5 on the Table Digital PCB.
   a. If there is no short, make sure the actuator is engaging the switch. If necessary, adjust the actuator.
   b. If the actuator is engaging the switch, check the wiring and connections. Access the bottom of the Cassette Tray to replace a faulty switch.
   c. If there is a short, check the connection on the Motron CPU PCB. You can test this film size on X11 pins 1 and 20. Use an ohmmeter to check the resistance of the cable.
   d. Power up the system and check the optoisolator IC16 on the Motron CPU PCB. The film size lines are optically isolated from the Motron PCB. Check IC16 pin 16. This pin will be near digital ground (150mV) when activated, or at +5 VDC when not activated. Replace the Motron CPU PCB if this circuit is not working.

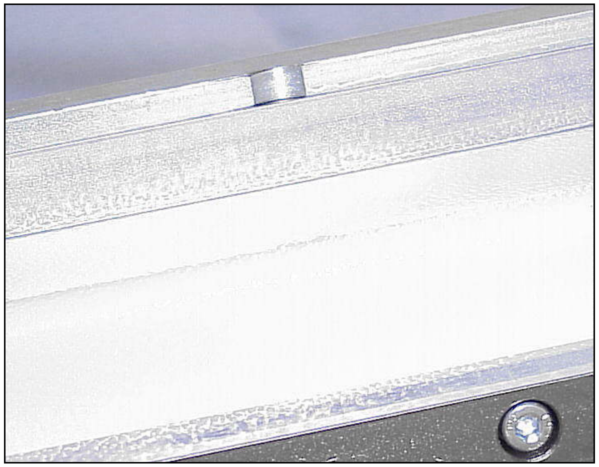
X-RAY ARM NOT READY or X-RAY BLOCKED

This message warns the user that the X-ray Arm is not fully extended and locked in the X-ray position. It's not possible to take X-rays under these conditions. S14, which closes when the X-ray Arm is fully extended, it is located at the back of the X-ray Arm, as shown in the following picture.



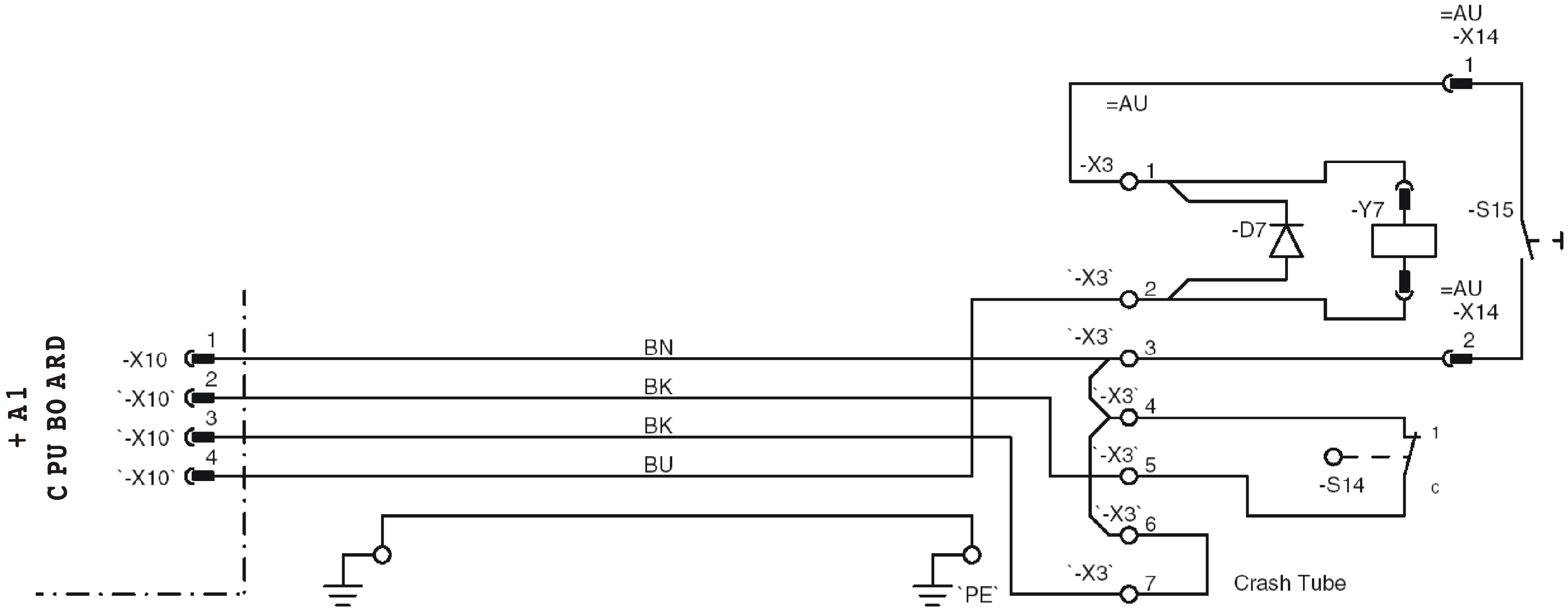
S14 at Back End of X-ray Arm

The actuator for S14 rides on the side of the X-ray Arm rail. When the X-ray Arm is fully extended, S14's actuator rides into a semicircle depression in the rail, closing S14. Otherwise, S14 remains open.



Detent for S14 in X-ray Arm Rail

Use the following schematic to check S14.


=AU
-X14
1
=AU
-X3
1
-Y7
-S15
-D7
`-X3`
2
=AU
-X14
2
`-X3`
3
+ A1
CPU BOARD
-X10
1
BN
`-X10`
2
BK
`-X10`
3
BK
`-X10`
4
BU
`-X3`
4
`-X3`
5
-S14
1
c
`-X3`
6
`-X3`
7
Crash Tube
`PE`

S14 and Related Circuitry

Use an ohmmeter to check S14 on pins 4 and 5 of Connector X3, which is just to the right of the actuator for S14, shown above. S14 connects to the Motron CPU PCB on Connector X10 pins 1 and 2. Pin 1 connects to +24 VDC, which returns through S14 to X10 pin 2. Faulty power, a bad switch, or a failure on the Motron CPU PCB could cause problems with this circuitry.

1. **Check +24 VDC on the Motron CPU PCB.** Check Connector X1 pins 1 and 4, using pin 4 as the ground. Make sure that LED D31 is lit. Make sure that +24 VDC is present on X10 pin 1.

CAUTION: Power down the system before performing the next step.

2. **Check S14**. Use an ohmmeter on Connector X3 pins 4 and 5. Measure the switch resistance. Move the X-ray Arm manually to see if the switch opens and closes.
3. **Check the connection on the Motron CPU PCB**. Use an ohmmeter on X10 pins 1 and 2. Move the X-ray Arm manually to see if the switch opens and closes.
4. **Check the optoisolator on the Motron CPU PCB**. Power up and check the optoisolator on the Motron CPU PCB. S14 is optically isolated from the CPU. Check IC17 pin 10. Pin 10 will be near digital ground (150 mV) when activated, or +5 VDC when not activated. Replace the Motron CPU PCB if this circuitry is not working.

FILM FAILURE - 36

This failure means that the Table didn't detect S12 opening within the calibrated range. Some possible causes are:

1. **The X-ray system (image chain) center position needs calibration** so that S12 is at the very top of the mechanical actuator cam. You may need to remove the Splash and Crash to see this adjustment best.
2. **The mechanical actuator cam or switch needs adjustment** so that S12 is fully actuated. Be careful when making the adjustment because you can damage the actuating lever on the switch if you make the adjustment too close. Enter table calibration mode for the X-ray system and use memory position buttons 1 or 3 to drive the film tray to the foot of the table. Then move the X-ray system to actuate S12. Loosen the screws that fasten either the switch or mechanical actuator cam, and reposition them. After you have done this, slowly drive the X-ray system off S12 and slowly back on. Then test for proper operation.

CAUTION: Power down the system before performing the next step.

3. **Bad connection on the Table Digital PCB**. Use an ohmmeter to check X3 between pins 1 and 6. You should see a low resistance with the film cassette parked at the head of the table with S12 closed.
4. **Bad connection on the Motron CPU PCB.** Remove plug from connector X11 on the Motron CPU PCB. Power up the system. Use a DVM to measure the voltage between connector X11 pins 1 and 25. You should see about 24 VDC.
5. **Bad optoisolator on the Motron CPU PCB**. Power up the system and check the optoisolator on the Motron CPU PCB. S12 is optically isolated from the CPU. Check optoisolator IC17 pin 14. Pin 14 will be near digital ground (150 mV) when activated (S12 closed) or +5 VDC when not activated. Replace the Motron CPU PCB if this function is not working.

MOTION FAILURE - 52

This message indicates a possible failure of relay K5 on the Relay PCB.

1. **Check the +24 VDC power on the Relay PCB**. Measure the voltage on connector X8 pins 1 and 2. Use pin 1 as ground. Make sure that LED 6 lights to indicate that +24 VDC is present.
2. **Check CPU connector** X9 pin 10 **on the Relay PCB**. We apologize that this is a ribbon cable connector, but there is no other place to look at this signal. This pin indicates the status of K5. When the relay is inactive, pin 10 should not have +24 VDC on it. If 24 volts is present, this is an indication that K5 is stuck closed. Pin 10 should have +24 VDC on it only when K5 is active. Replace the Relay PCB if K5 is not operating correctly.
3. **Check the Motron CPU PCB's optoisolator IC20**. The Motron CPU PCB connects by connector X5 to the Relay PCB. The K5 relay status line is optically isolated from the CPU. Power up the system and check the IC20 pin 16. Pin 16 will be near digital ground (150mV) when activated (K5 closed) or +5 VDC when not activated. Replace the Motron CPU PCB if IC20 is not working correctly.

MOTION FAILURE - 70

This is a general motion failure that the Motron CPU PCB asserts when it senses that potentiometer R5 is not moving. This could indicate a broken pot gear, bad power to the pot, bad power to motor M5, mechanical blockage or binding, or a broken belt.

1. Pot R5 Problems:
    a. Turn on system power and let the Table boot fully.
    b. Remove the Table Tower's top cover.
    c. Connect your laptop to the serial port, and enter the Service mode.
    d. Open the Utility Suite and select the Motron tool option.
    e. Open the oec_new.hpp file and select the Read CPU button.
    f. Select the Monitor button to open up a new window.
    g. Select option 2 to enter the Analog Test window.

h. Check the M5 line. If the value is between 25 and 1000, the pot is probably OK. If the value is outside this range, Table software does not allow Cassette movement and generates this error. Possible cause of this error are broken pot gear, bad potentiometer, bad analog 5 VDC, or analog ground bad or missing.

i Check the pot as follows:

(1) Remove inside stainless steel cover to get access to R5.

(2) Make note of potentiometer value on the M5 line and save this information for later use.

(3) Loosen nut on potentiometer and move the pot downward to disengage gear.

(4) Check the gear on the pot for cracks. You may have to remove the larger gear to make the inspection.

(5) While looking at the Analog Test window, spin the pot gear and see if the value on line M5 changes. Verify smooth operation and linear pot changes.

(6) Move the pot back to the value you recorded in step (2). Engage the pot gear to the film cassette gear. Tighten nut to hold potentiometer.

(7) Locate pot connector X13 on the Motron CPU PCB. R5 connects to pins 4, 5, and 12, with 12 being the wiper.

(8) Use an ohmmeter to verify whether the pot is good. You should read 10K ohms between pins 4 and 5.

(9) Check the voltage on X13 pins 4 and 5 on the Motron CPU PCB. You should see +5 VDC. Pin 5 is the analog ground pin. Check the voltage between pin 12 (the pot's wiper) and pin 5.

(10) Make sure LED D30 on the Motron CPU PB is lit. This is the voltage reference to the CPU A/D converter.

2. **Make sure the film transport carriage belt is not broken**. Check the belt for correct tension. A deflection of 3/8 inch (10mm) requires a force of 6 pounds (25N).

3. **Check the film transport carriage belt mounting bracket**. Use a metric allen wrench to check the two bolts that hold this bracket onto the filmer belt. If the bracket is loose, tighten it and recalibrate film cassette motion.

4. **Check motor power connections on** X5A. Make sure wires on connector are fully inserted. Measure voltage between phases. Measure between pins 1 and 2, pins 1 and 3, and pins 2 and 3.

5. **Check thermal protection on** X5B. Measure with an ohmmeter between pins 3 and 4. You should see continuity at 0.7 ohms. The thermal protection is normally closed and open when the motor is overheated.

6. **Check the brake solenoid**. Measure the solenoid resistance with an ohmmeter between pins 1 and 2 on X5B. You should see about 47 ohms. A short is an indication of a bad flyback diode on the coil or a shorted coil. A short circuit in the braking circuit may cause the Frequency Inverter to fail by not operating the brake release while the motor is driving.
7. **Check Connector X15**. X15 is the large connector near M5. Its pins are marked in rows 1 through 5 and columns A, B, and C. Inspect the pins. Use an ohmmeter to measure the resistance between the pin pairs identified in the table below. The same test can be done on Relay PCB connectors X5A and X5B.

Typical Resistance Between X15's Pins

Function	X15 Pin Pair	Resistance
Motor Coil	A1-B1	53Ω
Motor Coil	A1-C1	53Ω
Motor Coil	B1-C1	53Ω
Brake Solenoid	A2-B2	47Ω
Thermal Switch	A3-B3	0.1Ω
Chassis Ground	C5-Chassis	0.1Ω

8. **Make sure the film transport is free**. Inspect rails, rollers, and bearings. Make sure all move freely and do not bind.
9. **Check Fuse F3**. F3 is the current limiter for Frequency Inverter U2.

MOTION FAILURE - 102

Check Fuse F3. F3 is the current limiter for Frequency Inverter U2.

Table Vertical Movement and Tilt (M1 and M3)

Motors M1 and M3 work together to elevate and tilt the Table. The circuitry that causes these motions appears in the following block diagram.

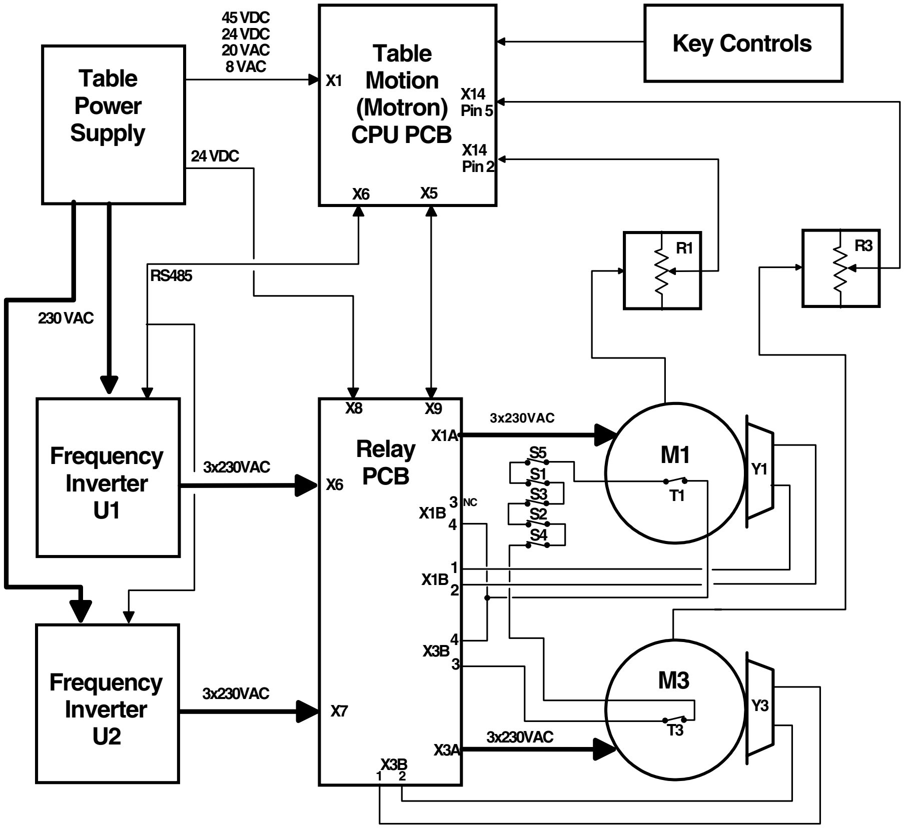


Table Power Supply
45 VDC
24 VDC
20 VAC
8 VAC
24 VDC
230 VAC
RS485
Table Motion (Motron) CPU PCB
X1
X14 Pin 5
X14 Pin 2
X6
X5
Key Controls
R1
R3
Frequency Inverter U1
3x230VAC
Frequency Inverter U2
3x230VAC
Relay PCB
X8
X9
X1A
X6
X1B
3
NC
4
1
X1B
2
4
X3B
3
X7
X3A
X3B
1
2
3x230VAC
S5
S1
S3
S2
S4
M1
T1
Y1
M3
T3
Y3
3x230VAC

Table Top Elevation and Tilt Circuitry

The following illustration shows the physical components that tilt the Table and move it vertically. Detailed descriptions of each component are available elsewhere in this chapter.

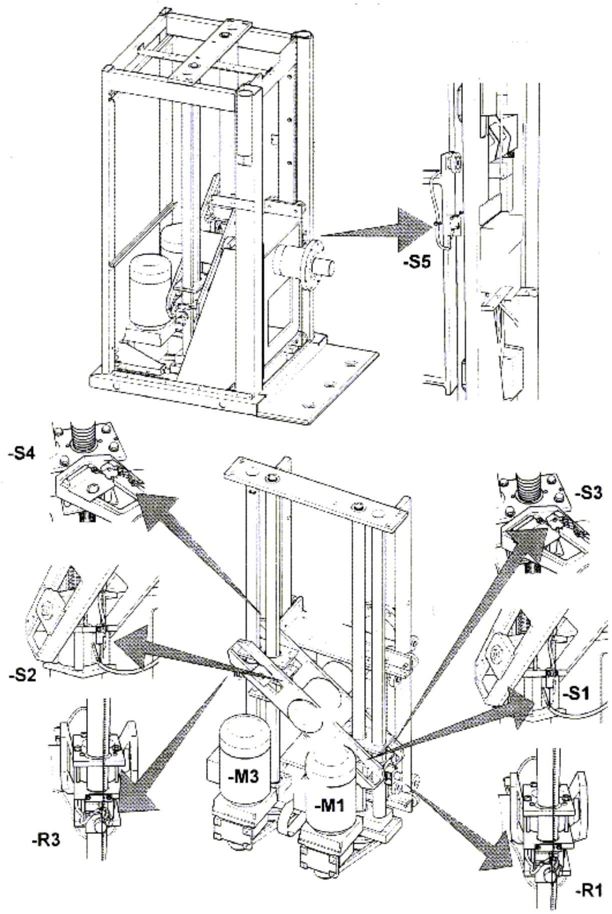
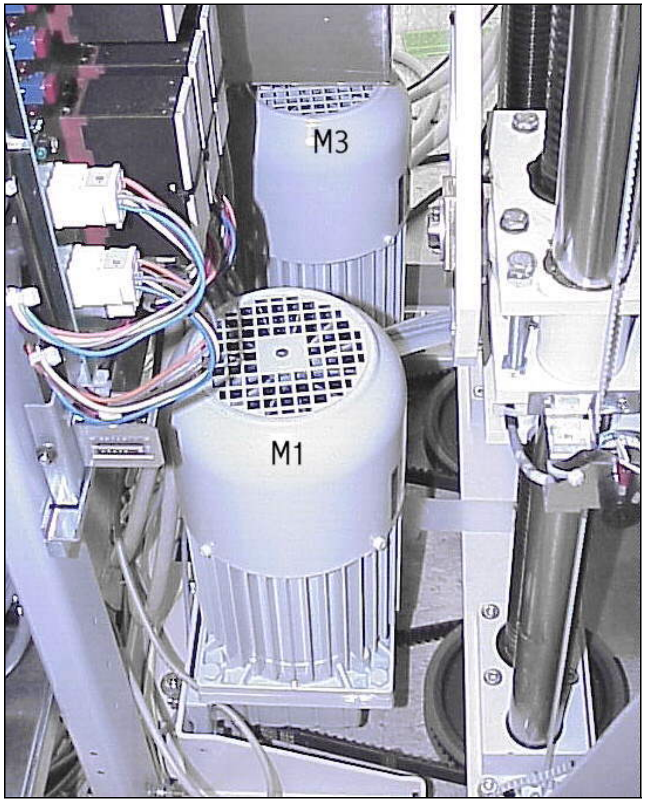


Table Vertical Movement and Tilt Components

Overview

When you press a vertical movement or tilt button on the hand or foot control, motors M1 and M3 work together to move the table. Each motor drives a jack screw. When you command the Table to move vertically, both motors turn at nearly the same speed to raise or lower the table. One motor turns at a constant rate while the other motor follows, adjusting its speed to keep the table's tilt angle constant. The Motron CPU PCB performs the calculations and controls the operation of each motor.



Motors M1 and M3

Two types of tilt are possible with the table. When you use the Hand Control, tilt occurs around the Table's central axis. M1 turns in one direction, while M3 turns in the opposite direction. When you use the foot control, the axis for the first 20 degrees of tilt is the non-moving end of the table. For example, if you are elevating the foot end of the Table, the head end remains the same height from the floor while the foot end goes up. After the tilt movement goes past 20 degrees, the axis of rotation reverts to the Table's central axis, and the head end begins to lower.

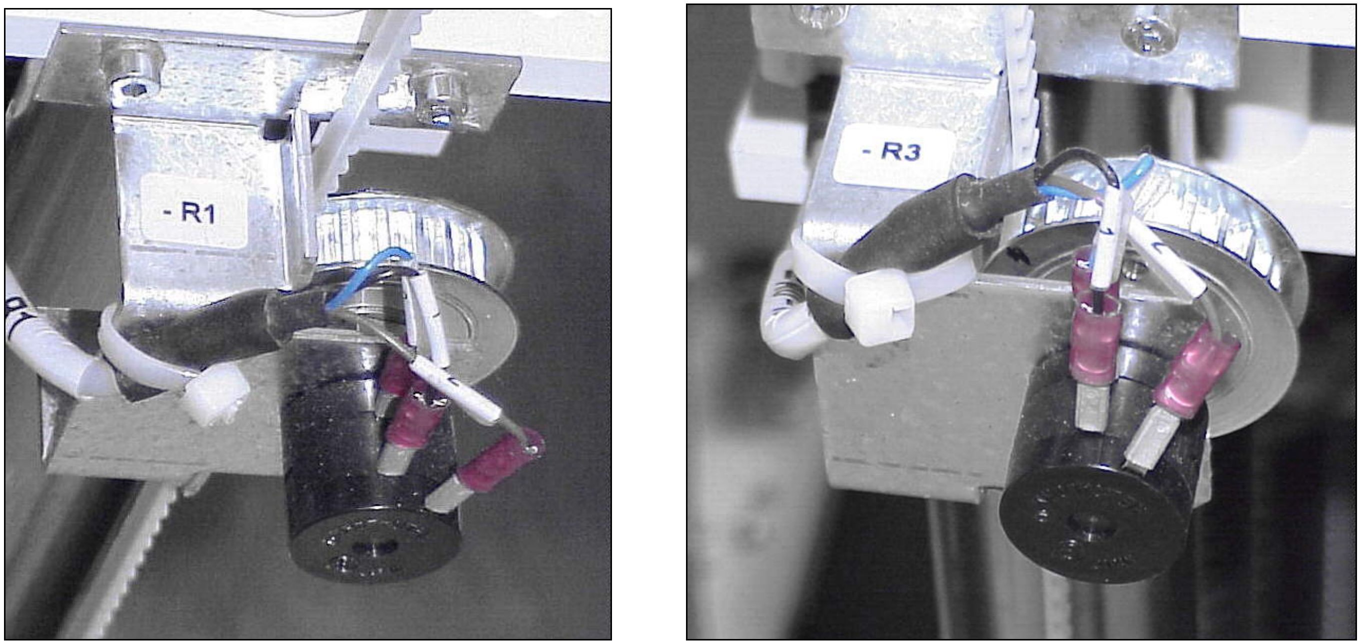
Table movement can occur only during a key closure. Each key control has two poles. One pole is the security line and the other pole commands the movement. Both poles must close or the Table won't move. If the Table is in motion and one pole opens, Table movement ceases.

Motor Control

The Motron CPU PCB uses an RS-485 serial link to control Frequency Inverters U1 and U2, which supply power to M1 and M3, respectively. The Motron CPU PCB sets up the control parameters for each motor from a stored parameter list. The Frequency Inverters convert single-phase AC input power to pulse-width-modulated, three-phase AC power that drives the motors.

Position Feedback Potentiometers

Motor M1 drives a large screw that moves one end of the Table up or down. A toothed belt installed vertically in the Tower turns a gear wheel on feedback potentiometer R1 as the M1 end of the Table moves. Motor M3 and Potentiometer R3 perform the same task for the opposite end of the Table. Another vertical toothed belt near Motor M3 drives feedback potentiometer R3. Pots R1 and R3 together provide Table height and tilt information to the Motron CPU PCB as an analog voltage on the wiper of each pot. The Motron CPU PCB performs an analog-to-digital conversion of each voltage, and compares the digital values to those in the stored parameter list (.hpp). When the Table is properly calibrated, the Motron always "knows" how high the Table is and which way it tilts.

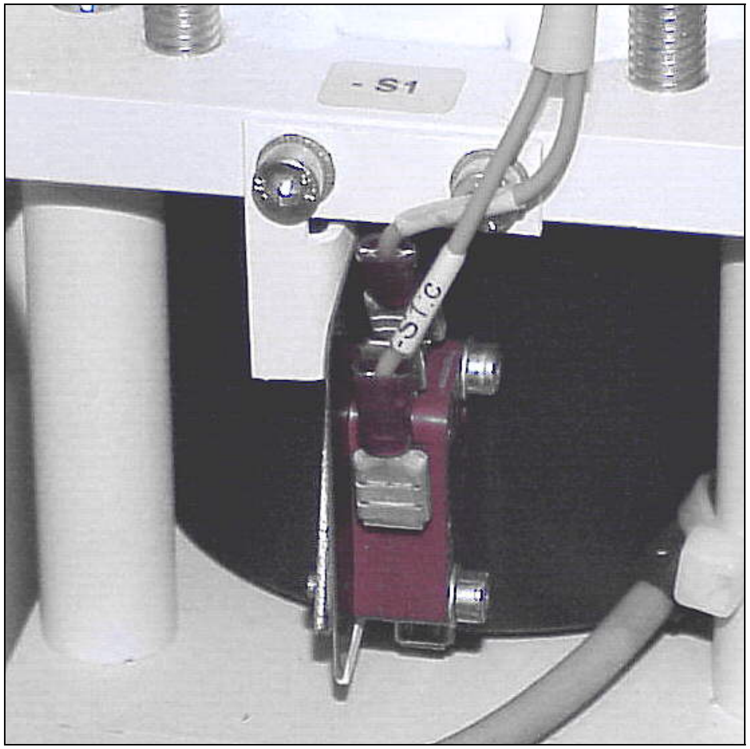


Potentiometers R1 and R3

Limit Switches

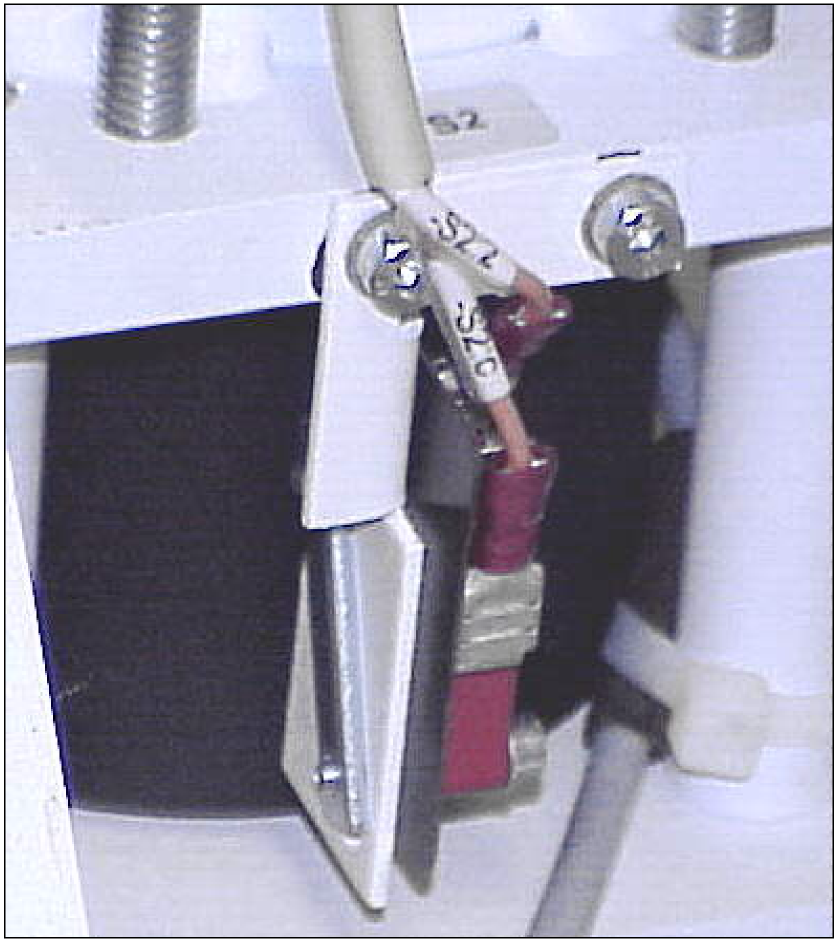
There are five safety limit switches for Motors M1 and M3. These switches are normally closed, but they open when they contact an acutator past their normal (software defined) travel limit.

Limit Switch S1 attaches to the safety nut on M1's jack screw. The switch engages the safety nut between the two steel plates above and below the nut. The safety nut should be centered between the two steel plates. When the safety nut moves from this center position, S1 disengages from the nut, opens the circuit, and stops Motors M1 and M3.



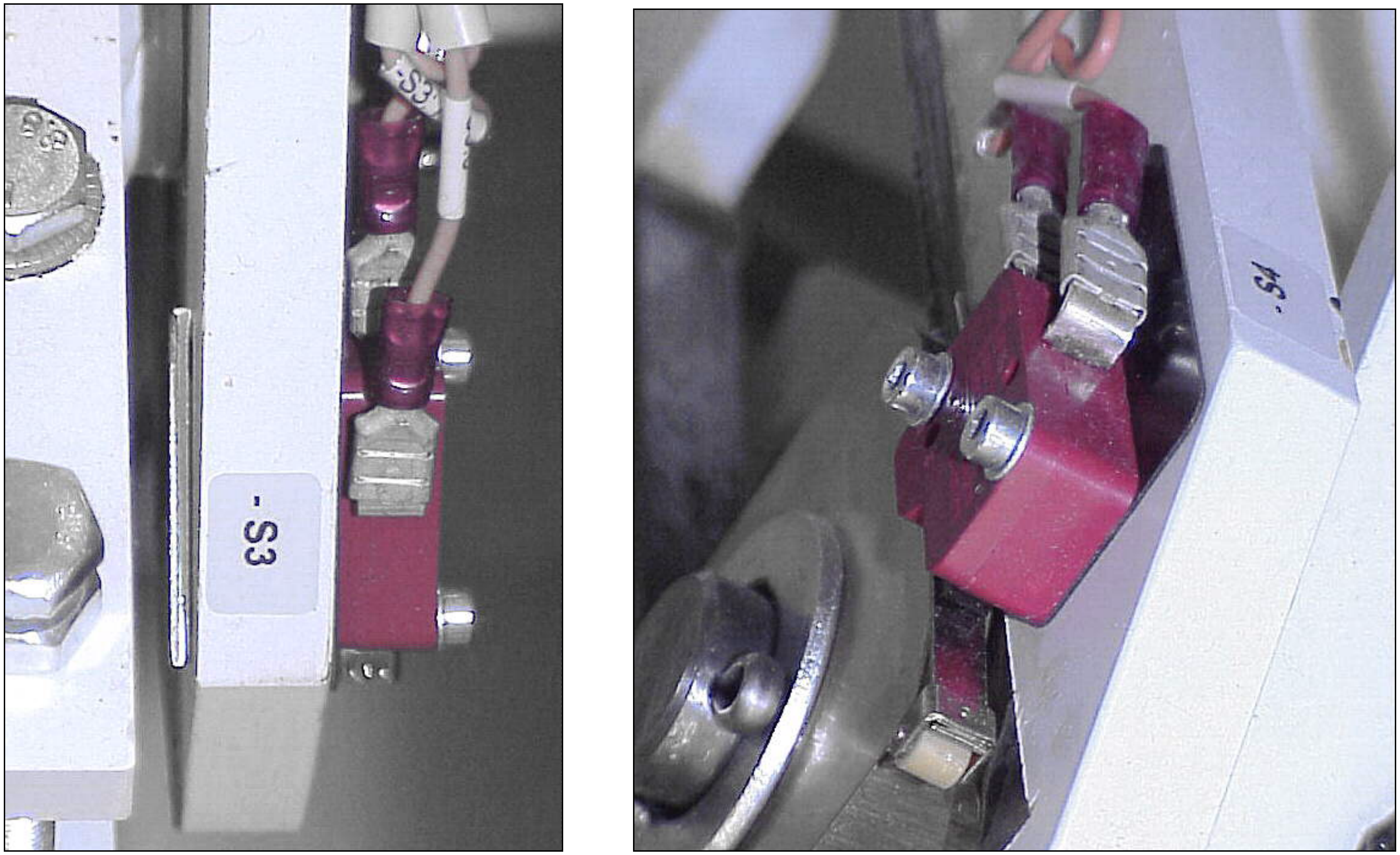
Limit Switch S1

Limit Switch S2 attaches to the safety nut on M3's jack screw. It operates the same way as Limit Switch S1, stopping both M1 and M3 when there is a hazard.



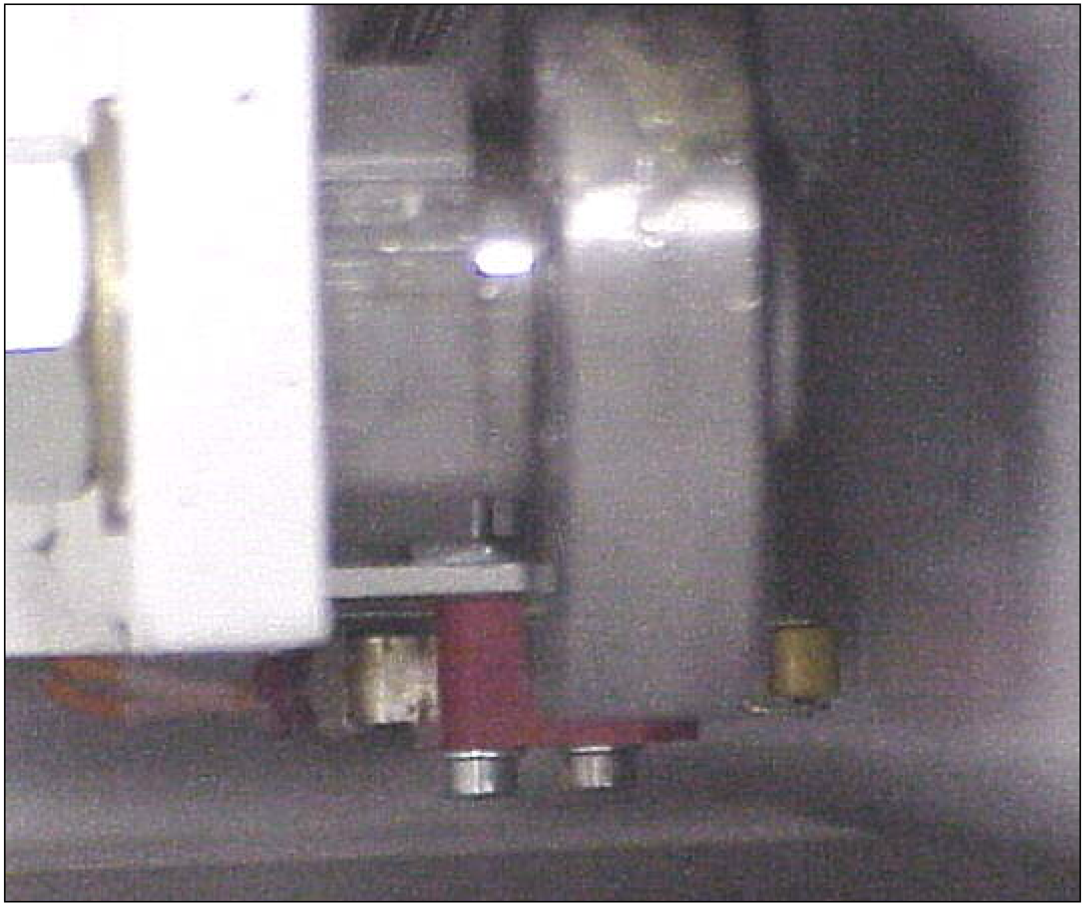
Limit Switch S2

Limit Switch S3 and Limit Switch S4 limit the Table's tilting motion. S3 mounts near the bronze rocker arm on the M1 jackscrew. If the Table tilts past the -20 degree head down position, the bronze rocker arm opens S3, shutting down motors M1 and M3. Limit Switch S4 works the same way, shutting down M1 and M3 if the Table tilts past the +88 degree position.



Limit Switches S3 and S4

Limit Switch S5 interrupts power to M1 and M3 when the Table passes the software limit for maximum or minimum vertical travel, pushing S5's actuator into a sheet metal stop that opens the switch. S5 is difficult to see without removing the Tower's front cover. Here's what it looks like peering down between the front cover and the chassis.



Limit Switch S5

Summary. The following table summarizes the functions of limit switches S1 through S5.

Limit Switches S1 Through S5

Limit Switch	Motor	Function	Normal Condition	Actuator
S1	M1	M1 Safety Nut	Engaged	Safety Nut
S2	M3	M3 Safety Nut	Engaged	Safety Nut
S3	M1	Tilt -20 degrees	Disengaged	Bronze Rocker Arm on M1
S4	M3	Tilt +88 degrees	Disengaged	Bronze Rocker Arm on M3
S5	Not associated with a jackscrew	Vertical	Disengaged	Vertical Column by Table on Transformer Side

Thermal Cutouts

Motor M1 and Motor M3 each have a built-in thermal cutout switch. T1 protects M1 and T3 protects M3. Each switch is normally closed, but opens if the motor it protects gets too hot.

Safety Switch Loop

Any open Limit Switch (S1 through S5) or Thermal Cutout Switch (T1 or T3) prevents M1 or M3 from moving by interrupting current to relays K1 and K3 on the Relay PCB. S1 through S5 and T1 and T3 connect in a series loop that connects to Relay PCB connector X3B on pins 3 and 4. This safety switch loop receives power from the emergency stop +24 VDC circuit on the Motron CPU PCB. This power travels out to the Table Digital PCB, and then back to the Motron CPU PCB.
LED V3 on the Table Digital PCB lights when the +24 VDC is present.

The Motron CPU PCB controls the base of a Darlington transistor pair for each relay on the Relay PCB. When the Motron CPU turns a Darlington pair on, the Darlington pair connects the coil of its associated relay to the +24 VDC ground on the Motron CPU PCB. When the Motron CPU PCB requests the M1 and M3 motors and the safety loop is intact, relays K1 and K3 close. When this happens, LED1 and LED3 that are across the K1 and K3 coils light.

Note: All the Relay PCB connectors that have a "B" in their reference designator (X1B, for example) are for the brakes and safety switches of each motor. Pins 1 and 2 are for brakes, with pin 2 being ground. Pins 3 and 4 are for motor safety switches.

If the Table runs beyond a tilt or elevation software limit and trips a limit switch, you can return the Table to its calibrated range by using the T1 and T3 Manual Override switches on the Relay PCB. Press both buttons together and use a tilt or elevation button to move the Table top back into normal operating range.

CAUTION! Use great care when operating Table tilt and elevation manually. It is easy to damage the jack screws and other components.

Motor and Braking Power

The following paragraphs explain how The Motron CPU PCB applies power and braking signals to M1 and M3.

Motor M1

Frequency Inverter U1 responds to commands from the Motron CPU PCB to provide drive power to Motor M1 or M2. U1 can power only one of these motors at a time. Relays on the Relay PCB switch power from U1 to the proper motor. K1 supplies power to Motor M1 and K2 supplies power to Motor M2. A normally-closed contact on K1 is in series with the coil of K2, and a normally-closed contact on K2 is in series with the coil of K1. This makes it impossible for Frequency Inverter U1 to power both motors at once.

Three-phase power from U1 enters M1 through connector X1A on the Relay PCB.

Note: All Relay PCB connectors that have an "A" in their reference designator (X1A, for example) supply three-phase power to a motor.

M1 has a brake that engages at all times except when +24 VDC is applied to it. When Frequency Inverter U1 applies three-phase AC power to M1, it also closes an internal relay that applies +24 VDC through Relay PCB connector X1B pins 1 and 2 to M1's brake, releasing the brake and allowing M1 to rotate.

Motor M3

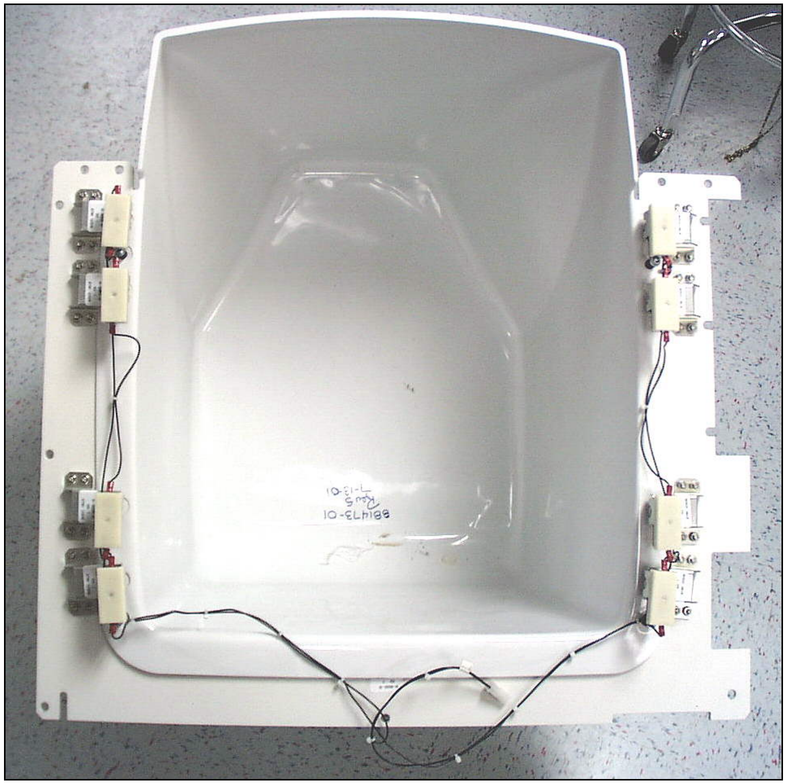
Frequency Inverter U2 responds to commands from the Motron CPU PCB to provide drive power to Motor M3, M4, or M5. U2 can power only one of these motors at a time. Relays on the Relay PCB switch power from U2 to the proper motor. K3 supplies power to Motor M3, K4 supplies power to Motor M4, and K5 supplies power to Motor M5. Holding current for the coil on the active relay travels through normally-closed contacts on the two inactive relays. For example, when M3 runs, Relay K3 energizes, and holding current for K3's coil travels through normally-closed contacts on de-energized relays K4 and K5. This makes it impossible for Frequency Inverter U2 to power more than one motor at the same time.

Three-phase power from U2 enters M3 through connector X3A on the Relay PCB.

Like M1, Motor M3 has a brake that engages at all times except when +24 VDC is applied to it. When Frequency Inverter U2 applies three-phase AC power to M1, it also closes an internal relay that applies +24 VDC through Relay PCB connector X3B pins 1 and 2 to M3's brake, releasing the brake and allowing M3 to rotate.

Splash and Crash Switches

The Splash and Crash switches that protect the Image Intensifier stop down, tilt, and Image Chain movements when one or more of the switches opens. The eight normally-closed, momentary open Splash and Crash switches are designated S1 through S8. The switches connect in series, and mount on the Image Intensifier cover as shown in the following illustration:



Splash and Crash Switches S1 through S8

Clearing a splash and crash condition is usually a matter of driving the Table high enough so the II cover no longer makes contact with the object that opened the protective loop. It is not necessary to reset the system. Under most conditions, the key controls start working again when the Motron CPU PCB determines that the Splash and Crash loop is restored and there is no longer a collision hazard.

The following illustration shows the Splash and Crash circuit.

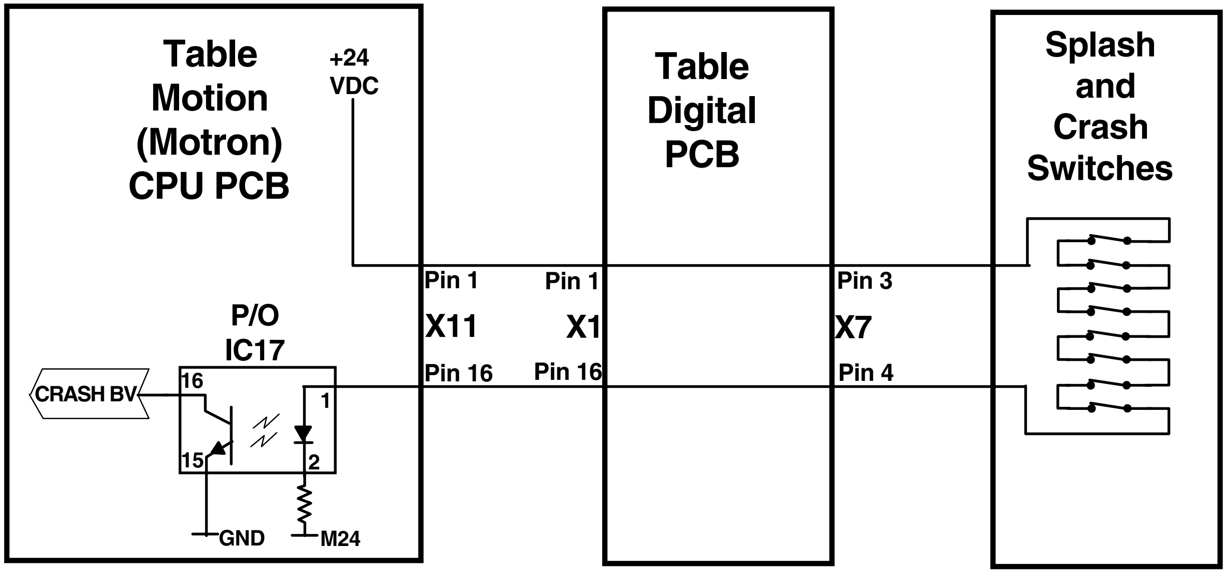


Table Motion (Motron) CPU PCB
+24 VDC
P/O IC17
CRASH BV
16
15
1
2
GND
M24
Pin 1
X11
Pin 16
Pin 1
X1
Pin 16
Table Digital PCB
Pin 3
X7
Pin 4
Splash and Crash Switches

Splash and Crash Circuit

The Motron CPU PCB outputs +24 VDC on pin 1 of connector X11. If there is continuity through the Splash and Crash series loop, +24 VDC is also present on pin 16 of X11. (Note that the Table Digital PCB only serves as a routing point for the Splash and Crash circuit.) The Motron CPU PCB uses the +24 VDC returned through the Splash and Crash loop to turn on an optoisolator in IC17, which causes IC17 pin 16 to stay at digital ground (150 mV or so) as long as the Splash and Crash loop is intact. The CRASH BV signal goes high (+5 VDC) when the Splash and Crash loop breaks. The processor halts all down, tilt, and Image Chain movement until CRASH BV goes low again.

Table Elevation Functional Test

You can move the Table top up or down using controls on the Table Hand Control or Table Footswitch. Unless it is calibrated differently, the Table travels from a minimum height of 78.5 cm (30.9 inches) to a maximum height of 122 cm (48 inches). Verify proper operation of the Table elevation function as follows:

1. Move Table to its maximum height. Table should move smoothly and quietly, and stop with its top at 122 cm above the floor (± .5 cm).
2. Move Table to its minimum height. Table should move smoothly and quietly, and stop with its top at 78.5 cm above the floor (± .5 cm).

Table Tilt Functional Test

A normally functioning Uroview 2800 Table tilts a maximum of +88 degrees up from level and a maximum of -20 degrees down from level. Tilt buttons are available on the Hand Control and a Tilt pedal is available on the Table footswitch. Use either of these controls to perform the following test, which evaluates the Table's Tilt function.

1. Tilt the Table upward until the Table reaches its positive tilt travel limit. The Table should move smoothly and quietly to its maximum upward inclination. Use a digital level to measure the inclination, which should be within one degree of +88 degrees.
2. Tilt the Table downward until the Table reaches its negative tilt travel limit. Use a digital level to measure the inclination, which should be within one degree of -20 degrees.

Error Messages

The following table lists error messages associated with vertical and tilt movement:

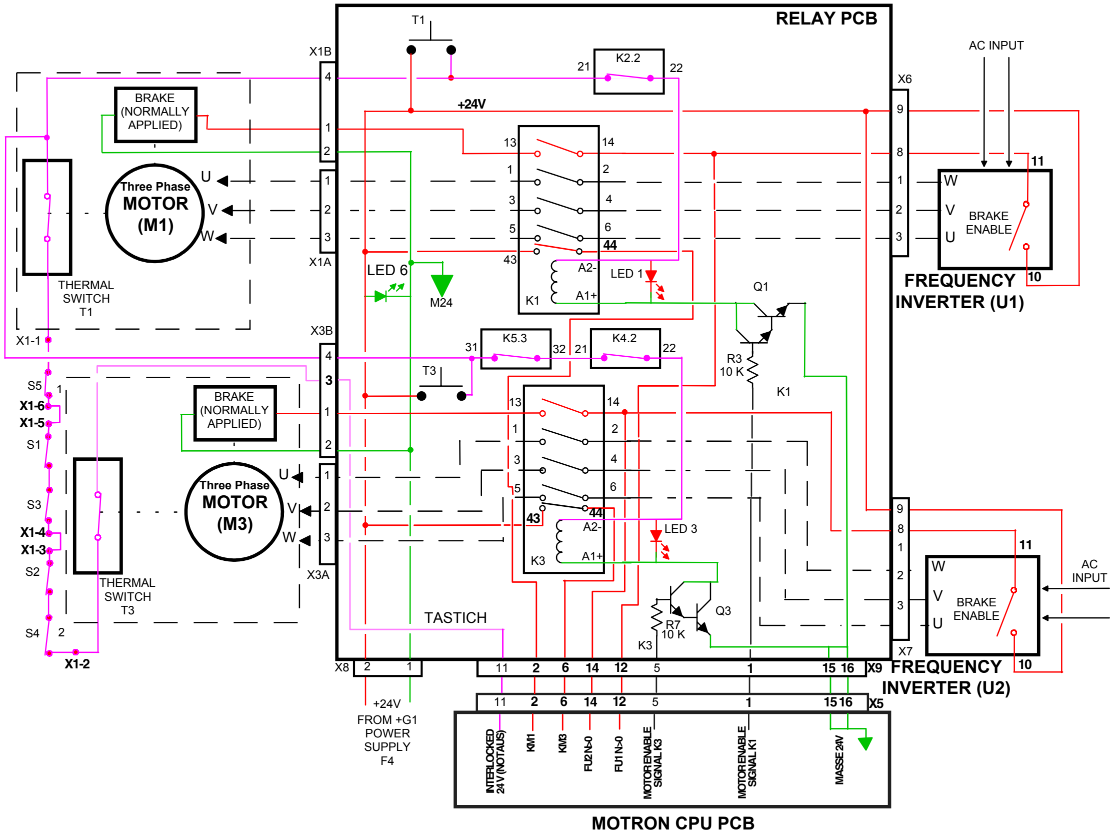
Error	Displayed Message	Logged Message	Code
Collision, Image Intensifier Cover	X-RAY BLOCKED (line 2) DOWN MOTION BLOCKED (line 3)	TBL II COVER COLLISION	42
Relay FU1 Frequency Problem - Motor Operating in Error	CALL SERVICE - 50 (line 2)	TBL FU1 FREQUENCY PROBLEM	50
Motor M3 Problem - Vertical/Tilt B	MOTION FAILURE - 54	TBL TILT MOTOR PROBLEM	54
Motor M1 Problem - Vertical/Tilt A	MOTION FAILURE - 56	TBL ELEVATION MOTOR PROBLEM	56
Analog voltage failed	TABLE COMMUNICATIONS FAILED (line 1) CALL SERVICE - 61 (line 2)	TBL ANALOG VOLTAGE FAILED	61
Tilt/Elevation Motion Blocked/Potentiometer R1 Problem	MOTION FAILURE - 62	TBL TILT MOTION FAILURE - R1	62
Tilt/Elevation Motion Blocked/Potentiometer R3 Problem	MOTION FAILURE - 63	TBL ELEVATION FAILURE - R3	63

Error	Displayed Message	Logged Message	Code
Relay FU0 Frequency Problem - Motor Operating in Error	CALL SERVICE - 67	TBL FL0 FREQUENCY PROBLEM	67
Limit Switch or gearbox overheating Problem M1 or M3	MOTION FAILURE - 71	TBL TILT/ELEVATION LIMIT OR OVERHEAT	71
Vertical Motion Stopped due to Calculated Motion Limit	*DOWN MOTION LIMITED		86
Frequency converter 0 for tilt/vertical system out of order	MOTION FAILURE - 101	TBLE FREQ CONVERT 0 ERROR	101
Frequency converter 1 for tilt/vertical, longitudinal, cassette out of order	MOTION FAILURE - 102	TBL FREQ CONVERT 1 ERROR	102
Potential Vertical height status - pre-calculated (M1+M3)/2	*MINIMUM HEIGHT		
Potential Vertical height status - pre-calculated (M1+M3)/2	*MAXIMUM HEIGHT		
Potentiometer Tilt Status - pre-calculated (M1-M3)	*MAXIMUM TILT		
Potentiometer Tilt Status - pre-calculated (M1-M3)	*MINIMUM TILT		

*Information only message. No corrective action required.

Troubleshooting

Use the following detailed block diagram and procedure to help you identify the cause of a consistent Table tilt or elevation failure.


RELAY PCB
T1
K2.2
21
22
+24V
X1B
X1A
X3B
X3A
X6
X7
X8
X9
X5
BRAKE (NORMALLY APPLIED)
Three Phase MOTOR (M1)
Three Phase MOTOR (M3)
U
V
W
THERMAL SWITCH T1
THERMAL SWITCH T3
X1-1
X1-2
X1-3
X1-4
X1-5
X1-6
S1
S2
S3
S4
S5
LED 6
M24
LED 1
LED 3
K1
K3
A1+
A2-
13
14
43
44
K5.3
K4.2
31
32
T3
Q1
Q3
R3 10 K
R7 10 K
TASTICH
AC INPUT
BRAKE ENABLE
FREQUENCY INVERTER (U1)
FREQUENCY INVERTER (U2)
+24V FROM +G1 POWER SUPPLY F4
INTERLOCKED 24 V (NOTAUS)
KM1
KM3
FU2 N>0
FU1 N>0
MOTOR ENABLE SIGNAL K3
MOTOR ENABLE SIGNAL K1
MASSE 24V
MOTRON CPU PCB

M1/M3 Detailed Functional Block Diagram

M1/M3 Problems

Question	Yes	No
1. Do Motors M2, M4, and M5 all work?	Step 8	Step 2
2. Analog Voltage Failure 61?	TABLE COMMUNICATIONS FAILED /CALL SERVICE - 61	Step 4
3. Problem solved?	End	Step 4
4. Frequency Inverter Error 50?	CALL SERVICE - 50	
5. Problem solved?	End	Step 6
6. Frequency Inverter Error 67?	CALL SERVICE - 67	
7. Problem solved?	End	Call Technical Support
8. Does Power Transformer need to be re-tapped?	Retap Power Transformer in accordance with Installation instructions	Step 10
9. Problem solved?	End	Step 10
10. Does Table tilt intermittently when driven vertically?	Monitor incoming power long enough to get a good idea of variability and set Power Transformer for lowest reading.	Step 13
11. Problem solved?	End	Determine which Frequency Inverter drives the unstable motor and replace that Frequency Inverter.
12. Problem solved?	End	Call Technical Support
13. Unexplained Splash and Crash Error?	Calibrate Table	Check pots, gears, and drive belts, and recalibrate Table.
14. Problem solved?	End	Call Technical Support

Question	Yes	No
15. Limit Switch Error 71?	MOTION FAILURE - 71	Step 17
16. Problem solved?	End	Call Technical Support
17. Pot Error 62?	MOTION FAILURE - 62	Step 19
18. Problem solved?	End	Call Technical Support
19. Pot Error 63?	MOTION FAILURE - 63	Step 21
20. Problem solved?	End	Call Technical Support
21. Error 101?	MOTION FAILURE - 101	Step 23
22. Problem solved?	End	Call Technical Support
23. Error 102?	MOTION FAILURE - 102	Step 25
24. Problem solved?	End	Call Technical Support
25. Error 54?	MOTION FAILURE - 54	Step 27
26. Problem solved?	End	Call Technical Support
27. Error 56?	MOTION FAILURE 56	Call Technical Support
28. Problem solved?	End	Call Technical Support

X-RAY BLOCKED - 42 / DOWN MOTION BLOCKED

An open switch on the Splash and Crash cover or a break in the Splash and Crash circuit causes this message. This usually occurs when an object hits or becomes lodged under the Image Intensifier cover, opening one or more of the eight Splash and Crash switches.

1. **Check the Splash and Crash Image Intensifier Cover**. Make sure that no objects hit or lodge under the cover. Make sure the cover properly attaches to the Table. Move the cover and verify that switches activate. Remove the cover from the Table and disconnect P7 from X7 on the Table Digital PCB. Measure the resistance of the loop at the ends pf P7. You should see very low-resistance continuity but not a dead short. Activate each switch to make sure it can both open and close the circuit. Check the gap on each switch while the cover is off the Table. The weight of the Splash and Crash cover can engage one or more switches while the Table tilts if each switch is not properly adjusted. Refer to sheet 4 of 2800 Interconnect Diagram 881504 to see the Splash and Crash circuitry. The "PCB Under the Table" on the Interconnect Diagram refers to the Table Digital PCB.
2. **Check the +24 VDC on the Table Digital PCB**. The power enters the Table Digital PCB on X1 pin 1 and exits into the Splash and Crash loop on X7 pin 3. Use X1 pin 13 or the anode of diode V1 as the ground reference. You can see this circuitry on Table Digital PCB Schematic 884244.
3. **Check the Splash and Crash Image Intensifier cover return**. Reconnect the Image Intensifier cover jumper wire to J7. Measure the voltage between X7 pin 4 and X1 pin 16. The output of the switches from the Image Intensifier crash cover is a straight trace from X7 to X1. Refer to Table Digital PCB Schematic 884244 and to sheet 4 of 2800 Interconnect Diagram 881504 to see this circuitry.
4. **Check the cable on the Motron CPU PCB**. Using X1 pin 4 on the Motron board as the ground reference, check for +24 VDC on X11 pin 16 (this connector is also on the Motron PCB). Connector X1 appears on sheet 11 of the Motron CPU PCB Schematic 884216 and connector X11 appears on sheet 6 of the same schematic.
5. Check optoisolator IC17 on the Motron CPU PCB. Connect your DVM's negative lead to pin 2 or the heat tab on IC12 (the +5 VDC regulator). Connect the positive lead to IC17 pin 16 (CRASH BV). The voltage on pin 16 should be near digital ground (150 mV or so). With the jumper removed from J7 on the II cover, the voltage on pin 16 should be +5 VDC. Replace the Motron CPU PCB if IC17 does not operate as it should. You can see IC17 on sheet 6 of Motron CPU PCB Schematic 884216. IC12 is on sheet 11 of the same schematic.

CALL SERVICE - 50

This message indicates a stuck brake relay on Frequency Inverter U2. Troubleshoot this problem as follows:

1. **Check the brake relay on Frequency Inverter U2**. WITH THE POWER OFF, check U2's relay on X7 pins 8 and 9 on the Relay PCB. With the power off, this relay contact should be open. U2 closes this relay to release the brake before running motor M3 or M5. A short across these contacts with the power off indicates a stuck brake relay inside Frequency Inverter U2. If this is the case replace Frequency Inverter U2. You can view this circuitry on sheet 2 of Relay PCB Schematic 884219 and on Table Block Diagram 885015.
2. **Check CPU connector** X9 **on the Relay PCB**. X9 pin 14 indicates the status of the brake relay on Frequency Inverter U2. When the brake relay is inactive (open), pin 14 should not have 24 VDC on it. +24 VDC on pin 14 indicates that the brake relay on Frequency Inverter U2 is stuck closed or that there is a short on the Relay PCB. Pin 14 should have +24 VDC on it only when the brake relay on U2 is energized. Replace the Relay PCB if a short is present on the Relay PCB. Refer to Relay PCB Schematic 884219 to view this circuitry.
3. **Check connector** X5 **on the Motron CPU PCB**. Specifically, check for +24 VDC on pin 14. Use X1 pin 4 as ground. You should see +24 VDC any time you activate the brake relay on Frequency Inverter U2. The brake relay should be active (closed) any time motor M3 or M5 moves. Refer to sheet 3 on Motron CPU PCB Schematic 884216 to see this circuitry.
4. **Check optoisolator** IC20 pin 12 **on the Motron CPU PCB**. Pin 12 will be near digital ground (150 mV) when the brake relay on Frequency Inverter U2 closes, and near +5 VDC when the brake relay is open. Use pin 2 or the heat tab on IC12 as ground. Replace the Motron CPU PCB if IC20 does not work correctly. Refer to sheet 3 on Motron CPU PCB Schematic 884216 to see this circuitry.

MOTION FAILURE - 54

This is a possible failure of K3 on the Relay PCB.

1. **Check the +24 VDC power on the Relay PCB**. Measure this voltage on X8 pins 1 and 2, using pin 1 as ground. Make sure that LED6 on the Relay PCB also lights to indicate that +24 VDC is present. This circuitry appears on sheet 1 of Relay PCB Schematic 884219.
2. **Check** X9 pin 6 **on the Relay PCB**. This pin indicates the status of Relay K3 on the Relay PCB. When the K3 is not energized, pin 6 should not have +24 VDC on it. If +24 VDC is present but K3 is not energized, K3 is probably stuck closed. Replace the Relay PCB if K3 does not appear to be working correctly. This circuitry appears on sheets 1 and 2 of Relay PCB Schematic 884219.
3. **Check the cable that runs between** X5 **on the Motron CPU PCB and** X9 **on the Relay PCB**. Verify that +24 VDC is present on X5 pin 6 when Relay K3 on the Relay PCB energizes. Replace the cable if +24 VDC is not present. This circuitry appears on sheet 3 of Motron CPU PCB Schematic 884216.
4. **Check optoisolator IC13 pin 12 on the Motron CPU PCB.** Pin 12 will be near digital ground (150 mV) when K3 is energized, and at +5 VDC when K3 is not energized. Replace the Motron CPU PCB if optoisolator IC13 does not operate correctly. You can see this circuitry on sheet 3 of Motron CPU PCB Schematic 884216.

MOTION FAILURE - 56

This is a possible failure of K1 on the Relay PCB.

1. **Check +24 VDC power on the Relay PCB**. Use X8 pins 1 and 2, with pin 1 as ground. Make sure that LED 6 is lit to indicate that +24 VDC is present on connector X8. Refer to sheet 1 on Relay PCB Schematic 884219 to see these components.
2. **Check connector X9 on the Relay PCB**. Check X9 pin 2, which indicates the status of K1. When K1 is energized, pin 2 should have +24 VDC on it. If +24 VDC is present on pin 2 when K1 is not energized, this is a good indication that K1 is stuck closed. Sheet 1 on Relay PCB Schematic 884219 shows these components.
3. **Check the cable that runs between X5 on the Motron CPU PCB and X9 on the Relay PCB**. Verify that +24 VDC is present on X5 pin 2 when Relay K1 on the Relay PCB energizes. Replace the cable if +24 VDC is not present.. This circuitry appears on sheet 3 of Motron CPU PCB Schematic 884216.

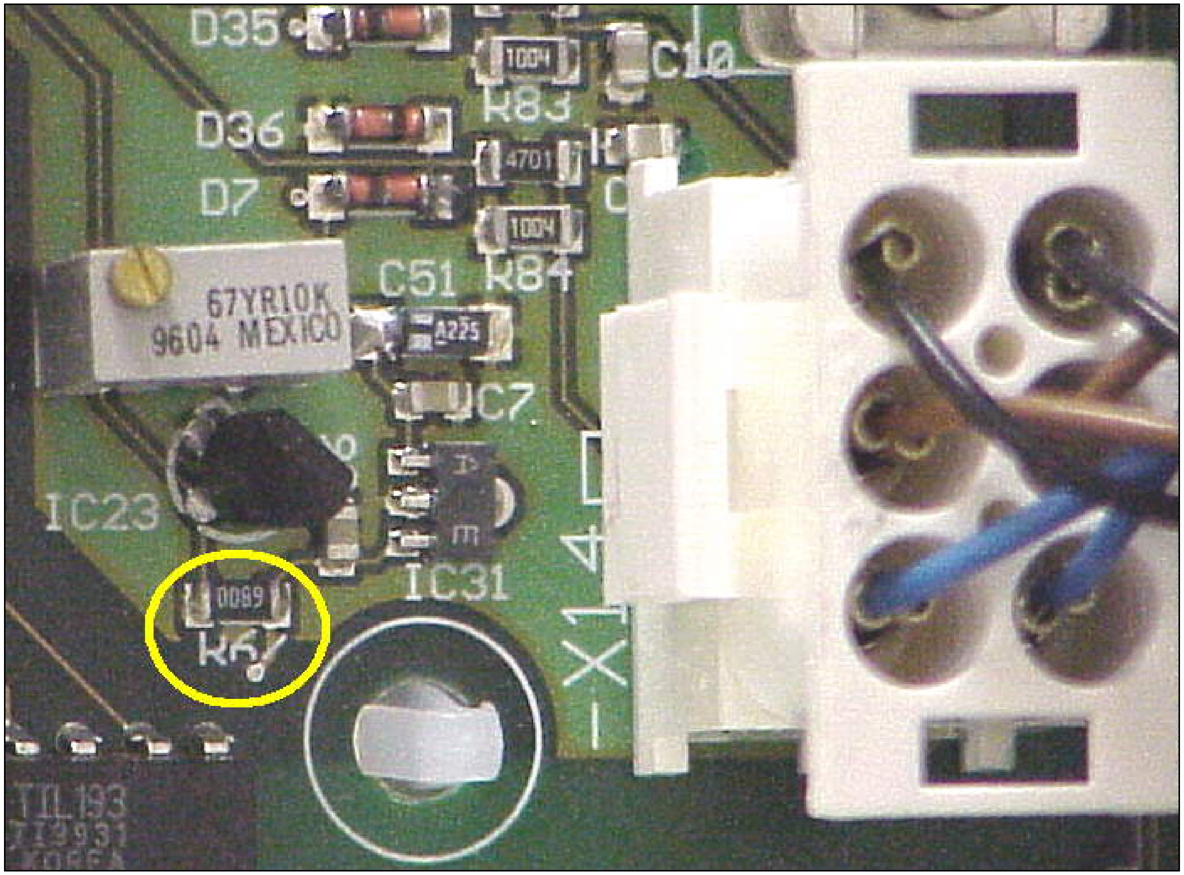
4. **Check optoisolator IC13 pin 16 on the Motron CPU PCB.** Pin 16 will be near digital ground (150 mV) when K1 is energized, and at +5 VDC when K1 is not energized. Replace the Motron CPU PCB if optoisolator IC13 does not operate correctly. You can see this circuitry on sheet 3 of Motron CPU PCB Schematic 884216.

TABLE COMMUNICATIONS FAILED / CALL SERVICE - 61

This error message is usually an indication that the analog +5 VDC (Vref) voltage to the Motron CPU PCB's analog-to-digital converter is bad.

1. Check LED 30 on the Motron CPU PCB. This LED should be lit because it monitors the input to the analog +5 VDC supply. If LED 30 is off, check Fuse F2 on the Motron CPU PCB. Refer to sheet 11 of Motron CPU PCB Schematic 884216 to see this circuitry.
2. **Check the voltage on connector** X14 **on the Motron CPU PCB**. Use pin 3 or 6 as the ground reference. Use pin 1 or 4 as the analog +5 VDC voltage. If +5 VDC is not present, replace the Motron CPU PCB. Refer to sheet 8 of Motron CPU PCB Schematic 884216 to see this circuitry.
3. **Remove plugs from Motron CPU PCB connectors** X13 **and** X14 **to unload the +5 VDC supply**. Remove all connectors to the position-reporting potentiometers and check the analog +5 VDC supply. Determine which connector loads down the supply. After you do that, find the short in the cable or pot. Refer to sheet 8 on Motron CPU PCB Schematic 884216 to see this circuitry.

4. **Check voltage reference to Motron CPU PCB's analog-to-digital converter**. Use pin 3 or 6 on connector X14 as the ground reference. Check the voltage on both sides of fixed surface-mount resistor R67 near connector X24, shown next. One side of the resistor should be at about +9 VDC and the other side should be at +4.99 VDC. If you get different results, replace the Motron CPU PCB. Refer to sheet 11 on Motron CPU PCB Schematic 884216 to see this circuitry.


D35
C10
1004
R83
D36
4701
D7
1004
C51
R84
67YR10K
9604 MEXICO
A225
C7
IC23
IC31
X14
0089
R67
TIL193

Resistor R67 Near Connector X14

MOTION FAILURE - 62

This is a general motion failure. The Motron CPU PCB generates this message when it senses that R1 is not moving. A broken toothed belt, loss of power to R1, loss of power to Motor M1, or mechanical binding or blockage can cause this message.

1. **Use the Utility Suite software to check potentiometer R1**.
   a. Turn on the system and let the Table boot fully.
   b. Remove the cover from the Table tower.
   c. Connect your laptop to the serial port and enter the Service mode.
   d. Open the Utility Suite software and select the Motron tool option.
   e. Open the oec_new.hpp file and select the Read CPU button.
   f. Select Option 2 to open the Analog Test window. Check the M1 line. If the value is between 25 and 100, the pot is probably OK. If the value is outside this range, the Table software does not allow vertical or tilt motion and generates the MOTION FAILURE -62 message.
2. **Check Potentiometer R1, as follows**:
   a. Remove the cover to gain access to R1
   b. Make note of the value for R1 shown in the M1 line of the Analog Test window. Save this value for use later in this procedure.
   c. Disengage potentiometer R1 from the toothed belt. Check the gear on the pot and the toothed belt for irregularities.
   d. While looking at the Analog Test window, spin the pot gear and see if the value shown in the window changes.
   e. Move the pot back to the value you saw in step b. Engage the pot gear to the toothed belt.
   f. Check R1 connections to X14 on the Motron CPU PCB. The pot connects to pins 1 through 3 with pin 2 being the wiper. Sheet 8 of Motron CPU PCB Schematic 884216 shows connector X14.
   g. Remove connector from X14 and check the resistance of pot R1. You should see 10 k ohms between pins 1 and 3.
   h. Check the voltage on X14 on the Motron CPU PCB. You should measure +5 VDC between pins 1 and 3. Pin 3 is analog ground. Check the voltage on the pot's wiper (pin2), which should be between 0 and +5 VDC. Make sure LED D30 is lit. This is the voltage reference to the Motron CPU PCB's analog-to-digital converter.

Sheet 8 of Motron CPU PCB Schematic 884216 shows connector X14.
Sheet 11 of Motron CPU PCB Schematic 884216 shows LED D30.

3. **Check Motor M1 power connections on Relay PCB connector** X1A First make sure wires on connector are fully inserted. Then measure the voltage between the phases while Motor M1 turns. Check pins 1 and 2, pins 1 and 3, and pins 2 and 3.

Note: The following measurements were made with the Table in motion. There should be no power on connector X1A when Motor M1 is not moving.

Left-Hand Motor M1 Typical Vertical Motion Operating Voltages Seen On Connector X1A

System Speed	Pins 1 to 2	Pins 1 to 3	Pins 2 to 3
Slow	210 VAC	210 VAC	210 VAC
Fast	250 VAC	250 VAC	250 VAC

Left-Hand Motor M1 Typical Tilt Motion Operating Voltages Seen On Connector X1A

System Speed	Pins 1 to 2	Pins 1 to 3	Pins 2 to 3
Slow	195 VAC	195 VAC	195 VAC
Fast	237 VAC	237 VAC	237 VAC

Note: Connector X1A appears on sheet 1 of Relay PCB Schematic 884219. Circuitry for Motors M1 and M3 appears in Wiring Diagram 885023.

4. **Check continuity of Safety Loop on Relay PCB connector** X3B. Measure the resistance between pins 3 and 4. You should see approximately .9 ohms. Thermal switches T1 and T3 are normally closed, opening only when M1 or M3

overheats. Safety switches S1 through S5 are also normally closed, opening only when the Splash and Crash encounters an obstacle. You can see connector X3B on sheet 2 of Relay PCB Schematic 884219. You can see the safety loop on Wiring Diagram 885023.

5. **Check Safety Loop Connector** X13**.** X13 is the inline Molex connector near Motor M3. One half of the connector goes to Motor M3 and the other half goes to Motor M1. Uncouple the two halves of the connector, and check the resistance between pins 1 and 2 on the connector half that goes to M1. This should be a closed loop with very low resistance. This loop contains Safety Switches S1 through S5 and Thermal Switch T1. Refer to Wiring Diagram 885023 to see this circuitry.
6. **Make sure both jack screws operate freely**. All mechanical parts associated with each jack screw should move through their complete range freely without binding.
7. **Check Fuse** F2. F2 is the currently limiter for Frequency Inverter U1. Refer to Power Supply Wiring Diagram 885025 to see Fuse F2. If F2 is open, be sure to replace it with the same fuse type and fuse size.

MOTION FAILURE - 63

This is a general motion failure. The Motron CPU PCB generates this message when it senses that R3 is not moving. A broken toothed belt, loss of power to R3, loss of power to Motor M3, or mechanical binding or blockage can cause this message.

1. **Use the Utility Suite software to check potentiometer R3**.
    a. Turn on the system and let the Table boot fully.
    b. Remove the cover from the Table tower.
    c. Connect your laptop to the serial port and enter the Service mode.
    d. Open the Utility Suite software and select the Motron tool option.
    e. Open the oec_new.hpp file and select the Read CPU button.
    f. Select Option 2 to open the Analog Test window. Check the M3 line. If the value is between 25 and 100, R3 is probably OK. If the value is outside this range, the Table software does not allow vertical or tilt motion and generates the MOTION FAILURE -63 message.
2. **Check Potentiometer R3, as follows**:
    a. Remove the cover to gain access to R3

b. Make note of the value for R3 shown in the M3 line of the Analog Test window. Save this value for use later in this procedure.

c. Disengage potentiometer R3 from the toothed belt. Check the pot gear and the toothed belt for irregularities.

d. While looking at the Analog Test window, spin the pot gear and see if the value shown in the window changes.

e. Move the pot back to the value you saw in step b. Engage the pot gear to the toothed belt.

f. Inspect R3 connections to X14 on the Motron CPU PCB. The pot connects to pins 4 through 6 with pin 5 being the wiper. Sheet 8 of Motron CPU PCB Schematic 884216 shows connector X14.

g. Remove connector from X14 and check the resistance of pot R3. You should see 10 k ohms between pins 4 and 6. If you see a short or an open circuit, check the pot itself. R3 appears on Wiring Diagram 885019.

h. Check the voltage on X14 on the Motron CPU PCB. You should measure +5 VDC between pins 4 and 6. Pin 6 is analog ground. Check the voltage on the pot's wiper (pin5), which should be between 0 and +5 VDC. Make sure LED D30 is lit. This is the voltage reference to the Motron CPU PCB's analog-to-digital converter.
Sheet 8 of Motron CPU PCB Schematic 884216 shows connector X14.
Sheet 11 of Motron CPU PCB Schematic 884216 shows LED D30.

3. **Check Motor M3 power connections on Relay PCB connector X3A** First make sure wires on connector are fully inserted. Then measure the voltage between the phases while Motor M1 turns. Check pins 1 and 2, pins 1 and 3, and pins 2 and 3.

Note: The following measurements were made with the Table in motion. There should be no power on connector X3A when Motor M3 is not moving.

Right-Hand Motor M3 Typical Vertical Motion Operating Voltages Seen On Connector X3A

System Speed	Pins 1 to 2	Pins 1 to 3	Pins 2 to 3
Slow	210 VAC	210 VAC	210 VAC
Fast	250 VAC	250 VAC	250 VAC

Right-Hand Motor M3 Typical Tilt Motion Operating Voltages Seen On Connector X3A

System Speed	Pins 1 to 2	Pins 1 to 3	Pins 2 to 3
Slow	195 VAC	195 VAC	195 VAC
Fast	237 VAC	237 VAC	237 VAC

Note: Connector X3A appears on sheet 2 of Relay PCB Schematic 884219. Circuitry related to Motors M1 and M3 appears in Wiring Diagram 885023.

4. **Check continuity of Safety Loop on connector** X3B. Measure the resistance between pins 3 and 4. You should see approximately .9 ohms. Thermal switches T1 and T3 are normally closed, opening only when M1 or M3 overheats. Safety switches S1 through S5 are also normally closed, opening only when the Splash and Crash encounters an obstacle. You can see connector X3B on sheet 2 of Relay PCB Schematic 884219. You can see the safety loop on Wiring Diagram 885023.
5. **Check Safety Loop Connector** X13**.** X13 is the inline Molex connector near Motor M3. One half of the connector goes to Motor M3 and the other half goes to Motor M1. Uncouple the two halves of the connector, and check the resistance between pins 1 and 2 on the connector half that goes to M1. This should be a closed loop with very low resistance. This loop contains Safety Switches S1 through S5 and Thermal Switch T1, all of which are normally closed. Refer to Wiring Diagram 885023 to see this circuitry.
6. **Make sure both jack screws operate freely**. All mechanical parts associated with each jack screw should move smoothly through their complete operating range without binding.
7. **Check Fuse** F3. F3 is the current limiter for Frequency Inverter U2. Refer to Power Supply Wiring Diagram 885025 to see Fuse F3. If F3 is open, be sure to replace it with the same fuse type and fuse size.

CALL SERVICE - 67

This error message indicates the brake relay inside Frequency Inverter U1 is stuck shut. Troubleshoot this problem as follows:

1. **Check the brake relay on Frequency Inverter U1**. WITH THE POWER OFF, check U1's relay on X6 pins 8 and 9 on the Relay PCB. With the power off, this relay contact should be open. U1 closes this relay to release the brake before running motor M1 or M2. A short across these contacts with the power off indicates a stuck brake relay inside Frequency Inverter U1. If this is the case, replace Frequency Inverter U1. You can view this circuitry on sheet 1 of Relay PCB Schematic 884219 and on Table Block Diagram 885015.
2. **Check connector** X9 **on the Relay PCB**. The voltage on X9 pin 12 indicates the status of the brake relay on Frequency Inverter U1. When the brake relay is inactive (open), pin 12 should not have 24 VDC on it. Unexpected +24 VDC on pin 12 indicates that the brake relay on Frequency Inverter U1 is stuck closed or that there is a short on the Relay PCB. Pin 12 should have +24 VDC on it only when the brake relay on U1 is energized. Replace the Relay PCB if a short is present on the Relay PCB. Refer to sheet 1 of Relay PCB Schematic 884219 to view this circuitry.
3. **Check connector** X5 **on the Motron CPU PCB**. Specifically, check for +24 VDC on pin 12. Use X1 pin 4 as ground. You should see +24 VDC any time you activate the brake relay on Frequency Inverter U1. The brake relay should be active (closed) any time motor M3 or M5 moves. If you do not see +24 VDC on X5 pin 12 at all, look for damage to the cable that runs between X5 on the Motron PCB and X9 on the Relay PCB. Refer to sheet 3 on Motron CPU PCB Schematic 884216 to see this circuitry.
4. **Check optoisolator** IC20 pin 14 **on the Motron CPU PCB**. Pin 14 will be near digital ground (150 mV) when the brake relay on Frequency Inverter U1 closes, and near +5 VDC when the brake relay is open. Use pin 2 or the heat tab on IC12 as ground. Replace the Motron CPU PCB if IC20 does not work correctly. Refer to sheet 3 on Motron CPU PCB Schematic 884216 to see this circuitry.

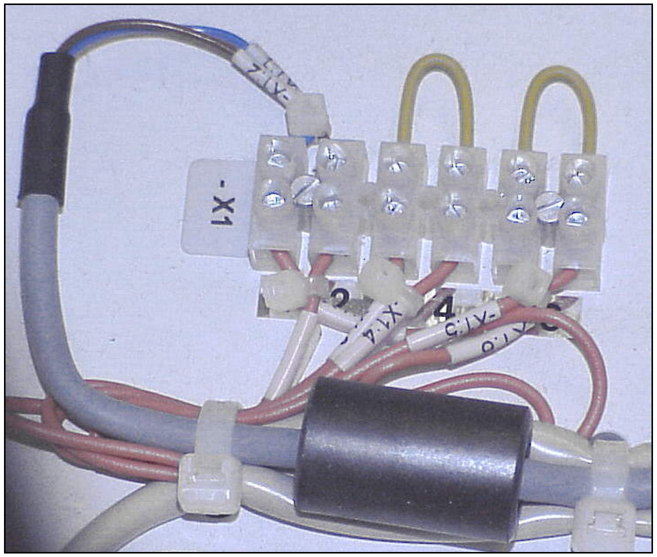
MOTION FAILURE - 71

Mechanical limit switches S1 through S5 connect in series with thermal switches T1 and T3. If any device in this normally-closed protective loop opens, neither M1 nor M3 will operate, and you will likely get the message MOTION FAILURE 71. You can check the entire loop at connector X3B on the Relay PCB. Refer to Wiring Diagram 885023 to see this circuitry.

1. **Check for continuity between X3B pins 3 and 4**. If the loop is OK, go to step 12.

2. **Check the Emergency Stop +24 VDC power on the Relay PCB**. Check X9 pin 11, using pin 15 or 16 on connector X9 for ground. If you see +24 VDC, go to step 4. If +24 VDC is not present, one of the Emergency Stop buttons may be engaged. Refer to sheet 1 of Relay PCB Schematic 884219 to see this circuitry.
3. **Check for Emergency Stop NOTAUS**. You can measure the NOTAUS on Relay PCB connector X9 pin 13, using pin 15 or 16 for ground. Refer to sheet 1 of Relay PCB Schematic 884219 to see this circuitry. Make sure that LED V3 on the Table Digital PCB is lit, indicating that 24 VDC NOTAUS is present on the Table Digital PCB.
4. **Check the +24 VDC on the Relay PCB**. Check X8 pin 2 using pin 1 as ground. Refer to sheet 1 of Relay PCB Schematic 884219 to see this circuitry.
5. **Check mechanical limit switches** S1 **and** S2. Each switch should be on and engaged with its respective safety nut. The safety nut should be in the middle of the two steel metal plates on the jackscrews. Refer to sheet 2 of Relay PCB schematic 884219, Relay PCB Wiring Diagram 885018, and M1/M3 Wiring Diagram 885023 for more information.
6. **Check mechanical limit switches** S3 **and** S4. Make sure neither switch is engaged by a brass actuator bar on a jack screw. Adjust the Table's calibration if either of these switches rests on an actuator bar. You can use manual override switch T1 or T3 in conjunction with a table movement button to move S3 or S4 off an actuator bar, and move the Table back into normal operating range. Refer to Relay PCB Wiring Diagram 885018, and M1/M3 Wiring Diagram 885023 for more information.
7. **Make sure that mechanical limit switch** S5 **is off the metal actuator bars.** Adjust the Table's calibration if this limit switch rests on an actuator bar. You can use manual override switch T1 or T3 in conjunction with a table movement button to move S5 off an actuator bar, and move the Table back into normal operating range. Refer to Relay PCB Wiring Diagram 885018, and M1/M3 Wiring Diagram 885023 for more information.

8. **Check mechanical limit switches S1 through S5 at connector** X1**.** The arrangement of this connector allows you to check the switches in pairs. Use the following table along with an ohmmeter to verify proper switch operation.



Connector X1 (Above) and Typical Limit Switch Resistances on Connector X1 (Below)

Function	Terminal Pair on Connector X1	Resistance
Vertical Limit Switch S5	1 and 6	.1Ω
M1 Limit Switches S1 and S3	4 and 5	.2Ω
M3 Limit Switches S3 and S4	2 and 3	.1Ω
Whole Switch Loop	1 and 2	.3Ω

Refer to Relay PCB Wiring Diagram 885018, and M1/M3 Wiring Diagram 885023 for more information.

9. **Verify operation of mechanical limit switches** S3**,** S4**, and** S5 by actuating each switch lever and checking all switch connections. Repair connections and replace faulty switches as necessary. Refer to Relay PCB Wiring Diagram 885018, and M1/M3 Wiring Diagram 885023 for more information.
10. **Check Thermal switch T1 and Motor M1**. There is a small Molex connector that joins wiring between motors M1 and M3. The connector is closest to M3 and connects by a short wire to M3. This connector appears as connector X13 on M1/M3 Wiring Diagram 885023. Separate the connector halves and identify the connector half that leads to Motor M1. Measure between X13 pin 2 and 1 on that connector half to determine if Thermal switch T1 is open or closed. This switch should be closed as long as Motor M1 is not hot, and mechanical limit switches S1 through S5 should also be closed because you checked them earlier in this procedure. Under normal operating conditions, you should see a small resistance on the ohmmeter between X13 pin 2 and 1. If T1 appears to be open, carefully check Motor M1 to make sure that it is indeed overheated. If Motor M1 is not overheated but T1 is open anyway, replace M1. If M1 is hot, try to determine the cause of the overheating. Look for binding mechanical parts, obstructed movement, and other external problems. If there is no obvious cause for the overheating, use the following table to check the windings on M1. Look for shorted or open windings. If M1 is faulty, replace it.

Motor M1 Typical Winding Resistances

Motor Part	Relay PCB Connector X1A Pins	Resistance
Motor Coil	1 and 2	7.2Ω
Motor Coil	1 and 3	7.2Ω
Motor Coil	2 and 3	7.2Ω

Refer to Relay PCB Wiring Diagram 885018, and M1/M3 Wiring Diagram 885023 for more information.

11. **Check Thermal switch T3 and Motor M3**. There is a small Molex connector that joins wiring between motors M1 and M3. The connector is closest to M3 and has a short wire tail to M3. This connector appears as connector X13 on M1/M3 Wiring Diagram 885023. Separate the connector halves and identify the connector half that leads to Motor M3. Short the two pins on this connector half together. Then measure between X3B pins 3 and 4 to determine if Thermal switch T3 is open or closed. This switch should be closed as long as Motor M3 is not hot. Under normal operating conditions, you should see a very small resistance on the ohmmeter between X3B pins 3 and 4. If T3 appears to be open, carefully check Motor M3 to make sure that it is indeed overheated. If Motor M3 is not overheated but T3 is open anyway, replace motor M3. If M3 is hot, try to determine the cause of the overheating. Look for binding mechanical parts, obstructed movement, and other external problems. If there is no obvious cause for the overheating, use the following table to check the windings on M3. Look for shorted or open windings. If M3 is faulty, replace it.

Motor M3 Typical Winding Resistances

Motor Part	Relay PCB Connector X3A Pins	Resistance
Motor Coil	1 and 2	7.2Ω
Motor Coil	1 and 3	7.2Ω
Motor Coil	2 and 3	7.2Ω

Refer to Relay PCB Wiring Diagram 885018, and M1/M3 Wiring Diagram 885023 for more information.

12. **Check the condition of relays** K4.2 **and** K5.3 by looking for continuity between the anode of D3 and X3B pin 4. This circuit is normally closed when K4 and K5 are not energized. The resistance you should see depends on how you've got the ohmmeter hooked up. With the red lead on the anode of D3, you'll see the forward-biased D3 diode junction. With the black lead on the anode of D3, you'll see the resistance of the relay coil. If you see an open circuit, the Relay PCB is defective and must be replaced. You can see this circuitry on sheet 2 of Relay PCB Schematic 884219.

13. **Check the condition of relay** K2.2 by looking for continuity between the anode of D1 and X1B pin 4. This circuit is normally closed when K2 is not energized. The resistance you should see depends on how you've got the ohmmeter hooked up. With the red lead on the anode of D1, you'll see the forward-biased D3 diode junction. With the black lead on the anode of D1, you'll see the resistance of the relay coil. If you see an open circuit, the Relay PCB is defective and must be replaced. You can see this circuitry on sheet 2 of Relay PCB Schematic 884219.

14. **Check the cable that connects between** X5 **on the Motron CPU PCB and** X9 **on the Relay PCB**. Be sure to check pins 1, 2, 5, 6, 15, and 16. Refer to sheet 3 of Motron CPU PCB Schematic 884216 to see connector X5, and refer to sheet 1 of Relay PCB Schematic 884219 to see connector X9.

15 **Check Interlock Relay K2**. Power down the Table. Connect an ohmmeter between Relay PCB connector X8 pin 2 (+24 VDC) and the cathode of flyback diode D1. The ohmmeter should read around 4M ohms when manual override switch T1 is not pressed. The ohmmeter should read about 180 ohms (the resistance of K1's coil) when T1 is pressed. If you don't get these results, Relay K2 is most likely bad, and you must replace the Relay PCB.

16. **Check Interlock Relays K4 and K5**. Power down the Table. Connect an ohmmeter between Relay PCB connector X8 pin 2 (+24 VDC) and the cathode of flyback diode D3. The ohmmeter should read about 4M ohms when manual override switch T3 is not pressed. The ohmmeter reading should drop to about 180 ohms (the resistance of K3's coil) when you press T3. If you don't get these results, K4 or K5 is probably bad and you must replace the Relay PCB.
Sheets 2 and 3 of Relay PCB Schematic 884219 show this circuitry.

17. **Check resistance of K1's coil**. Connect an ohmmeter across flyback diode D1, which is across K1's coil. Connect the meter so it doesn't forward bias D1. You should see a resistance of 183 ohms. If K1's coil is open, replace the Relay PCB.
Sheet 1 of Relay PCB Schematic 884219 shows this circuitry.

18. **Check resistance of K3's coil**. Connect an ohmmeter across flyback diode D3, which is across K3's coil. Connect the meter so it doesn't forward bias D3. You should see a resistance of 183 ohms. If K3's coil is open, replace the Relay PCB.
Sheet 2 of Relay PCB Schematic 884219 shows this circuitry.

19. **Check the M1 control signal for Relay K1 on the Relay PCB**. Using Relay PCB connector X8 pin 1 as ground, check the voltage on the top end of resistor R3 near manual override switch T1. When Motor M1 runs, this point should be near +24 VDC. When Motor M1 is not running, this point should be near 0 VDC. If +24 VDC is present on this point and motor M1 does not move, replace the Relay PCB. Darlington transistor Q1 is most likely bad.
Sheet 1 of Relay PCB Schematic 884219 shows this circuitry.

20. **Check the M3 control signal for Relay K3 on the Relay PCB**. Using Relay PCB connector X8 pin 1 as ground, check the voltage on the top end of resistor R7 near manual override switch T3. When Motor M3 runs, this point should be near +24 VDC. When Motor M3 is not running, this point should be near 0 VDC. If +24 VDC is present on this point and motor M3 does not move, replace the Relay PCB. Darlington transistor Q3 is most likely bad.
Sheet 2 of Relay PCB Schematic 884219 shows this circuitry.

21. **Check motor M1's control signal on the Motron CPU PCB**. Using Motron CPU PCB connector X1 pin 4 as ground, check the voltage on IC11 pin 15 (IC11 is also located on the Motron CPU PCB). When motor M1 runs, the voltage on IC11 pin 15

is near +24 VDC. When motor M1 is off, the voltage on IC11 pin 15 is 0 VDC. Replace the Motron CPU PCB if this signal is not present.

22. **Check motor M3's control signal on the Motron CPU PCB**. Using Motron CPU PCB connector X1 pin 4 as ground, check the voltage on IC11 pin 11 (IC11 is also located on the Motron CPU PCB). When motor M3 runs, the voltage on IC11 pin 11 is near +24 VDC. When motor M3 is off, the voltage on IC11 pin 11 is 0 VDC. Replace the Motron CPU PCB if this signal is not present.
23. **Check Relay K1's status on Relay PCB connector** X9 **pin 2**. When Relay K1 is active, there should be +24 VDC on pin 2. If pin 2 has +24 VDC on it when K1 is not active, K1 is probably stuck closed. Replace the Relay PCB.
    Sheet 1 of Relay PCB Schematic 884219 shows this circuitry.
24. **Check Relay K3's status on Relay PCB connector** X9 **pin 5**. When Relay K3 is active, there should be +24 VDC on pin 5. If pin 5 has +24 VDC on it when K3 is not active, K3 is probably stuck closed.
    Sheets 1 and 2 of Relay PCB Schematic 884219 show this circuitry.
25. **Check the optoisolator on the Motron CPU PCB that runs Relay K1**. Connect your DVM's negative lead to X1 pin 4, which is ground for +24 VDC on the Motron CPU PCB. Connect the positive lead of your DVM to optoisolator IC11 pin 15, which supplies +24 VDC to Relay K1 on the Relay PCB to turn it on, switching power to motor M1. When M1 runs, the voltage on IC11 pin 15 should be close to +24 VDC. When M1 is idle, IC11 pin 15 should be close to 0 VDC. Replace the Motron CPU PCB if it does not switch the +24 VDC to Relay K1 as it should.
26. **Check the optoisolator on the Motron CPU PCB that runs Relay K3**. Connect your DVM's negative lead to X1 pin 4, which is ground for +24 VDC on the Motron CPU PCB. Connect the positive lead of your DVM to optoisolator IC11 pin 11, which supplies +24 VDC to Relay K3 on the Relay PCB to turn it on, switching power to motor M3. When M3 runs, the voltage on IC11 pin 11 should be close to +24 VDC. When M3 is idle, IC11 pin 11 should be close to 0 VDC. Replace the Motron CPU PCB if it does not switch the +24 VDC to Relay K3 as it should.

DOWN MOTION LIMITED

This message on a Vacuum Fluorescent Display means that an installed Table accessory has reached a software-calculated motion limit. Switches S16, S17, and S18 in the Tabletop attachment tube sense the attached accessory. The Motron CPU PCB calculates new Tabletop longitudinal, tilt, and down motion stops for different accessories. This prevents the Table accessories from hitting the ground when the Table is in a positive tilt. Refer to the M4 motor section under Collision Prevention for more information.

MOTION FAILURE - 101

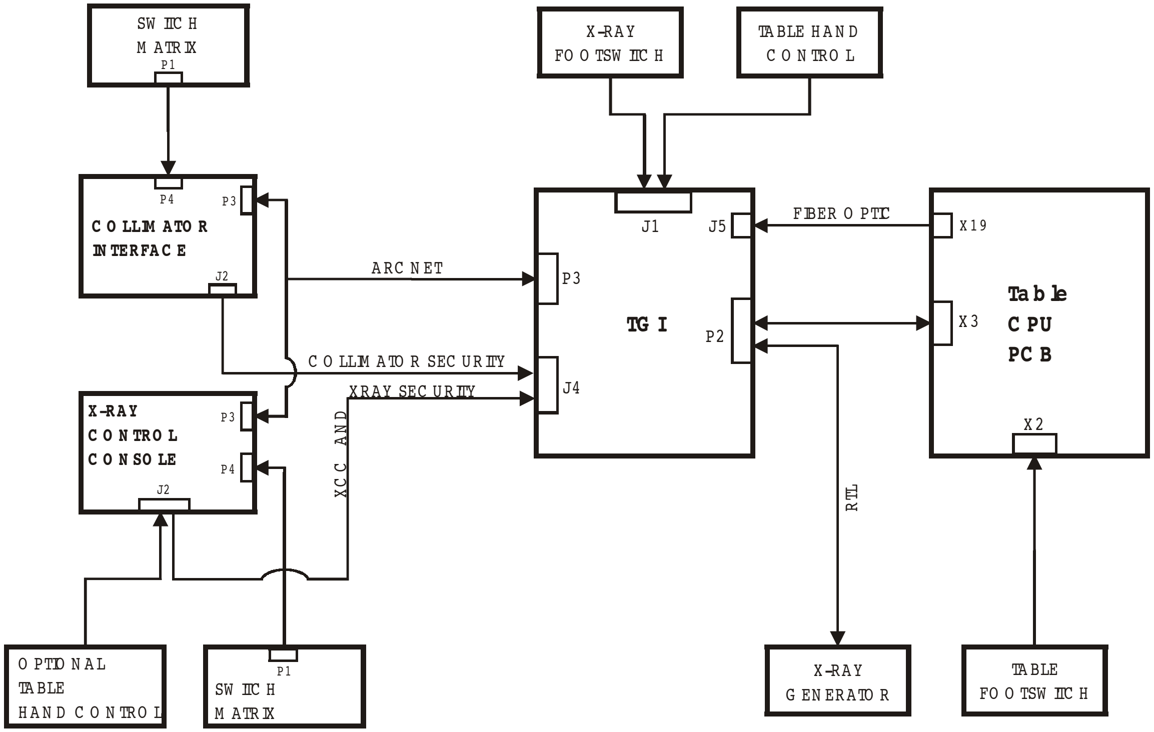
This is an indication that Fuse F2, which protects Frequency Inverter U1, is open. Turn off the power and use an ohmmeter to examine the fuse. If it is open or looks damaged, replace it with another fuse of the same type, physical size, and capacity. Power Supply Wiring Diagram 885025 shows this circuitry.

MOTION FAILURE - 102

This message is an indication that Fuse F3, which protects Frequency Inverter U2, is open. Turn off the power and use an ohmmeter to examine the fuse. If the fuse is open or looks damaged, replace it with another fuse of the same type, physical size, and capacity. Power Supply Wiring Diagram 885025 shows this circuitry.

Key Controls

The following block diagram shows the UroView 2800 key controls:


SWITCH MATRIX
P1
X-RAY FOOTSWITCH
TABLE HAND CONTROL
P4
P3
COLLIMATOR INTERFACE
J2
ARCNET
J1
J5
FIBER OPTIC
X19
P3
TGI
P2
X3
Table CPU PCB
COLLIMATOR SECURITY
XRAY SECURITY
J4
X-RAY CONTROL CONSOLE
P3
P4
J2
XCC AND
RTL
X2
OPTIONAL TABLE HAND CONTROL
P1
SWITCH MATRIX
X-RAY GENERATOR
TABLE FOOTSWITCH

Key Controls Block Diagram

All controls except the Pausch foot control communicate with the table via the Table Generator Interface (TGI) board. When table motion occurs, the Table Motion (Motron) CPU PCB communicates the position pot values to the TGI twice each second. If there is no table motion for 30 seconds, software on the TGI requests status information from the Motron CPU PCB. If the TGI does not receive a telegram over the fiber optic cable, it puts up the message TABLE COMMUNICATIONS ERROR ON THE VFD. Three possible causes of this error are:

1. Problems with cable 881633 (sheets 4 and 6 of Interconnect Diagram 881504 show this cable.)
2. The Motron board locking up or detecting a failure either at boot up or during operation.
3. The Fiber Optic cable 882299 is bad or has become disconnected. (Sheets 4 and 6 of Interconnect Diagram 881504 show this cable.)

For a quick test of this cable and the Motron CPU PCB, remove the fiber optic cable from the TGI board and look at the end of the cable while moving the table. If a light does not blink at the end of the fiber optic cable there is something wrong with the cable or transmitter on the Motron CPU PCB. Check out the transmitter the same way.

Table Hand Control

This control unit (pn 901571) plugs into X4 under the table. The circuit then continues via J7 on the backpack to the TGI board. The TGI then communicates with the Table CPU PCB over the fiber optic cable. The table hand control communicates with the TGI board using Manchester encoded communications. When a button is pressed on the hand control, it is encoded and sent out to the TGI, where it is decoded and sent to the Table CPU board. At this time, if table security is active, the Table CPU board commands the table to move in the desired direction. The table will continue to move until the button is released, a software stop has been reached, or an error is detected.

This control unit gives you control over the following:

1. Table movement
2. Table position memory functions (3 settings)
3. Load position recall control

Table Foot Control

This control unit plugs into X8 under the table. An interconnecting cable plugs into the Y-Distribution PCB mounted on the Motron CPU Motherboard.

Note: *The 00-901941–01 rev A version of the Motrol CPU PCBs requires a separate Y – Distribution board. In the rev B version, the Y – Distribution board function is included on the Motron CPU PCB, making a separate board unneccessary.*

Every button on the foot control has 2 poles. The first pole is for table motion security and the second pole is for motion command. When you press a button on the foot control, the command to drive the table is sent directly to the Table CPU board. At this time, if the table security is active, the Table CPU board commands the table to move in the desired direction. The table will continue to move until the button is released, a software stop has been reached, or an error is detected.

This control unit gives you control over the following:

1. Table and X-ray image chain movement
2. Table position memory functions (1 setting)

Collimator Control Panel

The collimator control panel (Central Control Panel) is located at the front of the x-ray tube and collimator. All collimator control commands are processed and executed locally by this software node. Table movement button presses are converted into ARCNET commands and sent to the TGI for processing and communication with the Table CPU PCB. Table movement and position memory buttons contain motion security circuits. This signal is required for any table movement and is passed on to the Table CPU PCB without any software control. Collimator light control is sent via ARCNET to the TGI, where it is then passed on to the Table CPU board. This board contains the relay, power supply, and timing control for the light. All user interface commands except table motion commands sent from the optional x-ray control console are processed here. This means that if a button is pressed on the x-ray control console, that board converts the button press into an ARCNET command and sends it to the collimator interface node for processing and delivery to the appropriate destination. Mag mode is also controlled by the table. The key press is interpreted by the collimator node software then sent to the TGI and on to the table. The table sets the II controls and reports back to the TGI which mag mode is selected. The TGI and collimator software then sets the rest of the system to the selected mag mode.

This control unit gives you control over the following:

1. Tabletop and x-ray image chain movement
2. Collimator control
3. Mag mode control
4. Table position memory functions (3 settings)
5. Load position recall control
6. Alarm reset
7. Collimator light on request
8. Film mode request

X-ray Control Console

This control unit monitors button presses (user interface commands), and passes these commands on to the collimator interface node via the ARCNET for processing. The optional hand control port (J8) commands are converted into ARCNET commands and sent directly to the TGI board for processing and passing on to the Table CPU PCB. Table motion and x-ray security circuits are provided here. These signals are sent to the TGI board directly without any software control. A request for entering film mode requires the operator to press and hold the film mode request button down until the LED beside the button quits blinking and turns on steady. This is because the UROVIEW 2800 image chain moves to align the film tray and the x-ray beam. This table motion, like all table motion, requires table motion security to be present as long as motion is required. Even if the x-ray system is already aligned with the film tray, software requires the security signal to be present until the system is fully into film mode.

This control unit gives you control over the following:

1. Collimator control
2. Collimator light on request
3. Workstation Save, Swap and Mode controls
4. Image orientation controls

5. PIP (Picture in Picture) controls
6. X-ray generation
7. KV and MA control
8. Alarm reset
9. X-ray mode controls
10. Film mode request
11. Ion chamber control
12. Film exposure adjustment control
13. Optional x-ray control console hand control
    A. Table position memory functions 3 settings
    B. Load position recall control

X-ray Footswitch

X-ray generation and PIP (Picture in Picture) can be commanded from here. This device is plugged into X9 under the table and has an interconnecting cable that goes to the TGI board. The commands to generate x-rays are processed on the TGI board, but the PIP commands are converted into an ARCNET command, and sent to the collimator interface board. There they are processed and sent back to the TGI board via ARCNET, then on to the video standards converter for execution.

1. PIP (Picture in Picture) controls
2. X-ray controls

Fiber Optic Communications.

This communication is one-way, from the Table CPU PCB to the TGI board. The table sends table position information while the table is in motion, status information such as film size, user correctable error messages, and table failures. For a complete description of this communication, refer to document 881824. If the table has not been moved for 30 seconds, software on the

TGI board requests status from the table via the cable connected to X3 on the Table CPU PCB. It will do this every 30 seconds until a table movement is commanded; the 30-second counter is reset after table movement has stopped.

Film Mode Button

When you press the film mode button, the request is transmitted via ARCNET to the TGI board. Here the TGI opens fluoro request relay K1 and closes film request relay K2. This applies +24V on P2-25 of the TGI board. The signals from these relays are passed to X9 on the Table CPU PCB. This 24V is applied to pin 1 of IC18 where the command to enter film mode is sensed. If all conditions for entering film mode are present, the Table CPU PCB commands the film tray to move to the foot end of the table. When the Table CPU PCB senses opening of film alignment switch S12, it closes relay K16. This shorts pins 3 and 4 of X9 together. These pins are connected to P2 pins 8 and 27 respectively on the TGI. Pin 27 is shorted to ground. Pin 8 is pulled up to VCC. An X9 closure on the Table CPU PCB shorts pin 8 to ground. Software detects this logic low on U25 pin 4 and turns on the LED by the film mode request buttons. For a more in-depth discussion on this matter go to the M5 motor discussion. Refer to the M5 motor discussion for more information.

Troubleshooting Tips

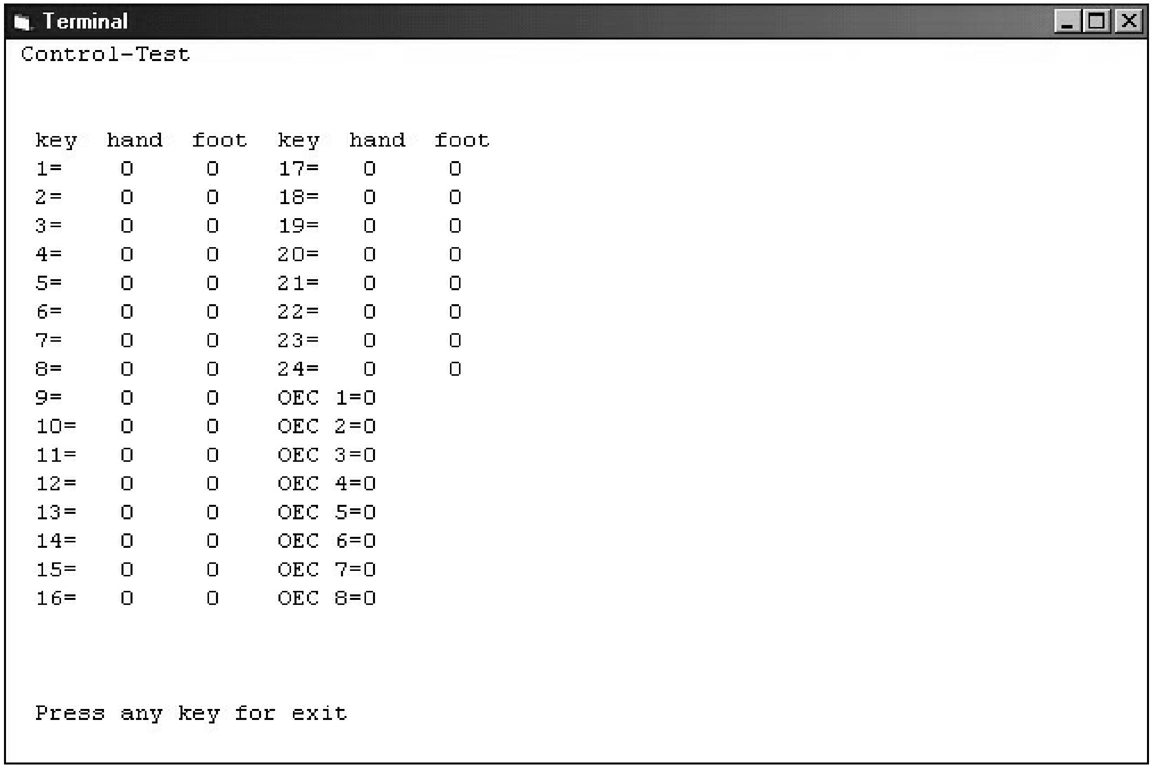
Note: The following discussion assumes that the Table CPU board is fully booted and ready to move the table.

If you are having problems with a control unit, run the following test to verify the table is seeing the key presses.

1. Turn on the system power and let the table boot fully.
2. Remove the cover from the top of the table tower; connect your computer to the serial port, and enter service mode.
3. Open up the utility suite software and select the Motron tool option.
4. Open up the oec_new.hpp file and select the READ CPU button.
5. Select the MONITOR button. This will open up a new window.
6. Select option 3. This will display the CONTROL – TEST window (see next picture).

   In the CONTROL-TEST window, a “key” number is assigned to each table movement control button. When you press a button on one of the control panels, the zero at the corresponding key number will change “1”.

7. Press a button on the control unit you suspect, while watching its corresponding key number in the CONTOL-TEST window. If the button press does not result in the corresponding zero to changing to “1”, you probably have either a connecting cable problem or a bad switch on the control panel. Refer to the drawings below for the key number corresponding to each control panel button.
8. Repeat for each button on the control panel, verifying that every one works. If all keys fail, the indicated fault is not the same as if some keys are OK and others not. This is explained further in the troubleshooting tables provided later in this document. However, in either case the result in the same—you have to replace the entire control unit.

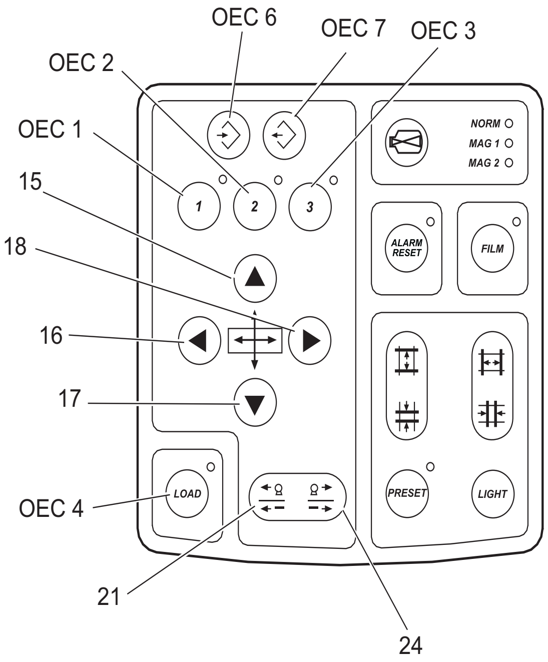


```
Control-Test


 key  hand  foot  key  hand  foot
 1=    0     0    17=   0     0
 2=    0     0    18=   0     0
 3=    0     0    19=   0     0
 4=    0     0    20=   0     0
 5=    0     0    21=   0     0
 6=    0     0    22=   0     0
 7=    0     0    23=   0     0
 8=    0     0    24=   0     0
 9=    0     0    OEC  1=0
 10=   0     0    OEC  2=0
 11=   0     0    OEC  3=0
 12=   0     0    OEC  4=0
 13=   0     0    OEC  5=0
 14=   0     0    OEC  6=0
 15=   0     0    OEC  7=0
 16=   0     0    OEC  8=0



 Press any key for exit
```

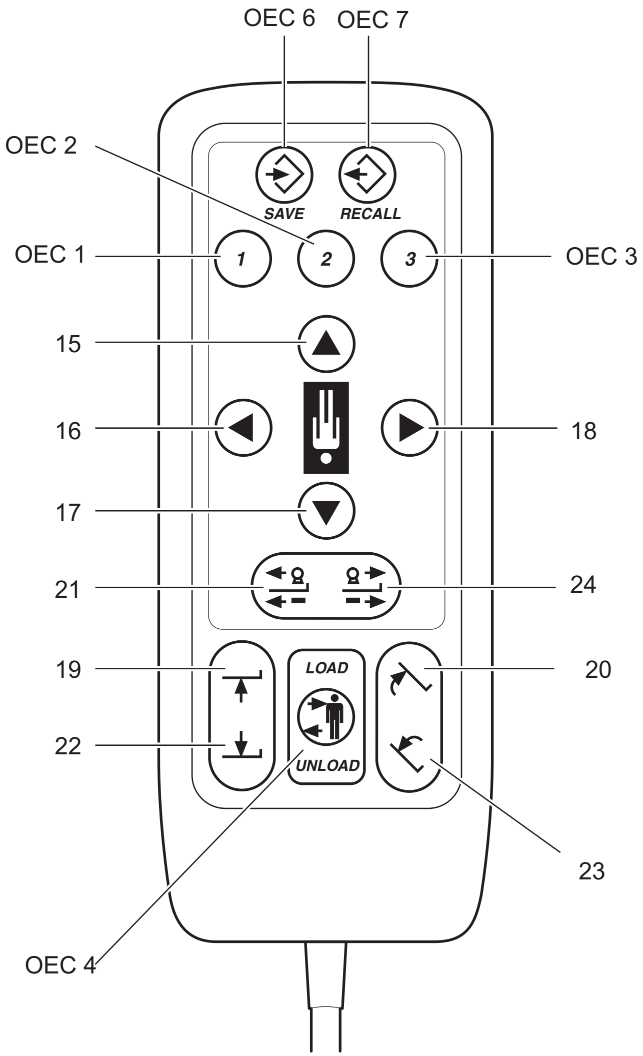
CONTROL – TEST Window: Each Key Number Corresponds to a Control Unit Button

Key Number Associated to Table Movement	
Key number	**Action**
1 to 14	Not used by OEC UroView® 2800
15	Tabletop longitudinal toward foot
16	Tabletop lateral to patient left
17	Tabletop longitudinal toward head
18	Tabletop lateral to patient right
19	Elevation up
20	Tilt head up
21	Image chain toward head end
22	Elevation down
23	Tilt head down
24	Image chain toward foot end
OEC 1	Memory Position 1
OEC 2	Memory Position 2
OEC 3	Memory Position 3
OEC 4	Move Table to Load Position
OEC 5	(not used)
OEC 6	Save Position
OEC 7	Recall Position
OEC 8	(not used)

Note: The callouts in the following pictures are the key numbers that appear in the CONTROL – TEST window.


OEC 6
OEC 7
OEC 3
OEC 2
OEC 1
15
18
16
17
OEC 4
21
24
NORM
MAG 1
MAG 2
1
2
3
ALARM RESET
FILM
LOAD
PRESET
LIGHT

Collimator Control Panel Buttons and their Corresponding Key Numbers


OEC 6
OEC 7
OEC 2
SAVE
RECALL
OEC 1
1
2
3
OEC 3
15
16
18
17
21
24
19
LOAD
20
22
UNLOAD
23
OEC 4

Hand Control Buttons and their Corresponding Key Numbers

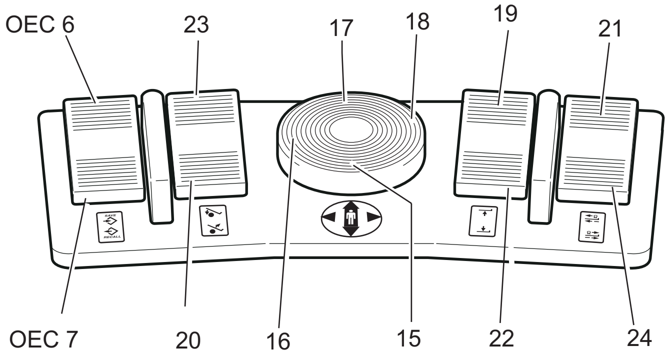


Table Foot Control Buttons and their Corresponding Key Numbers

Table Movement Security

All table motors except the film cassette require the security circuit to be closed before movement is possible. The cassette is internal to the table and thus does not pose a risk to the operator. However, it will not move if the film tray door is open. When the security circuit is closed, that signal is transferred to the table without any software control.

If table movement fails no matter which control you use, follow the troubleshooting instructions below.

Problem	**Probable Cause**	**Remedy**
Table does not move with a control button press	security circuit error or motion security is missing	Perform Control Circuit test.
		Fully press and hold the control unit button. Within 10 seconds the “CALL SERVICE –60” error will show up if the control unit sending out commands to move the table
LED D55 is lit without someone pressing a table motion button	Faulty control unit. One of the table motion control units is closing this circuit	Perform Control Unit Test
LED D55 stays lit after a button is pressed and released	Sticking relay	Perform Stuck Relay test

Control Circuit Test

Lightly press and hold a table motion button on the hand control. This press should not be hard enough to feel a detent. Hold this button for at least 10 seconds. D55 on the Table CPU motherboard will light up when the security signal is present. If an error “CALL SERVICE –60” is displayed on the VFD within the 10 seconds time frame the security circuit is working as designed. Releasing the button and pressing it fully will clear this error. If this error doesn’t occur there is a problem with the security circuit or control unit. It is possible for one button on a control unit to fail.

Control Unit Test

Start disconnecting them one at a time to see which one is causing the fault. For the Hand switch, remove the Splash and Crash cover and remove it from X4 under the table. Collimator control switch panel; disconnect connector J10 inside the table backpack. X-ray control console; disconnect J15 inside the table backpack. TGI; disconnect cable P3 of cable 881633 from the Table CPU motherboard. Table footswitch; disconnect the cable going into the Y-Distribution board (see Note above).

Stuck Relay Test

If LED D55 stays lit after a button is pressed and released on a table footswitch, Relay K8 on the Table CPU board is probably sticking. If the problem happens with all control units except the table footswitch, K3 on the TGI board is probably sticking. There is an approximate 500 milliseconds delay built into the Relay K8 on the Table CPU board after the button is released. If LED D55 is lit longer than this delay, Relay K8 or the Table CPU board may be the problem.

Table Hand Control Security

If you have problems only with the table hand control (not the Pausch hand control), troubleshoot as follows:

Problem	**Probable Cause**	**Remedy**
All table hand controls fail	Faulty interconnecting cables	Troubleshoot the associated cable conductors and connectors..
Some buttons fail, others OK	Faulty table hand control	Perform Table Hand Control check

Hand Control Check

Every button press on the GE OEC hand control (pn 901571) closes a two-pole switch. The first pole that closes is the security switch and then after a detent is felt the table movement pole is closed. When the security pole is closed, it shorts P4-3 to +12Vdc on P4-6.   Remove connector P1 on the TGI board and measure between pins 2 and 4. There should be around 200 ohms when a button on the hand control is pressed. Verify this with all the hand control buttons. If all hand control buttons fail, check the interconnecting cables. If a few buttons fail, suspect the hand control. (Refer to pages 6 and 8 of 2800 Interconnect Diagram 881504 for more information.)

Collimator Control Table Security

If you have trouble with table motion when directed from the Collimator Control Panel, troubleshoot as follows:

Problem	Probable Cause	Remedy
All Collimator Control Panel table motion buttons fail	Faulty interconnecting cables	Troubleshoot the associated cable conductors and connectors.
	Faulty +12 VDC power supply	Troubleshoot Power Supply PS 1
Some buttons fail, others OK	Faulty Collimator Control Panel	Perform Collimator Control Panel check.

Collimator Control Panel Check

The buttons on the collimator switch panel (pn 901654) that can invoke table movement contain 2 pole switches. The first pole that closes is the security switch and then after a detent is felt the table movement pole is closed. When the security pole is closed it shorts out pins J10-1 to J10-3. With the system power on disconnect J10 inside the backpack. While pressing a table movement button on the collimator switch panel measure between J10-1 and J10-3. If the security circuit is functioning there will be 12Vdc between those pins. Verify this with all collimator table motion buttons. If all the table motion buttons fail, check the interconnecting cables and +12V power supply. If only a few buttons fail, suspect the switch panel. Refer to sheets 2 and 6 of 2800 Interconnect Diagram 881504 for more information.

Footswitch Control Security

If you have problems with the Pausch Footswitch control, troubleshoot as follows:

Problem	**Probable Cause**	**Remedy**
All footswitch controls fail	Faulty interconnecting cables	Troubleshoot the associated cable conductors and connectors. Try swapping DMM leads.
Some footswitch controls OK	Faulty footswitch assembly	Perform Pausch Foot Control check.

Pausch Foot Control Check

Every button press on the Pausch Foot Control (pn 883965) closes 2 pole switches. The first pole closed is the security switch then the motion command pole is closed. With the footswitch it is hard to close one without the other but can be done using your hands to press the pedals. The security pole closure shorts pins 3 and 9 of the cable going into the Y-Distribution board. Measure this circuit and verify on all pedals of the foot switch. If all switches fail, check the interconnecting cables; try to swap the leads of your multi meter. If only a few switches fail, suspect the foot switch. . Refer to
sheet 4 of 2800 Interconnect Diagram 881504 for more information.

X-Ray Control Table Security For Film Mode And Optional Hand Control

If you have problems with the GE OEC hand control when selecting film mode, troubleshoot as follows:

Problem	**Probable Cause**	**Remedy**
All switches fail	Faulty interconnecting cables	Troubleshoot associated conductors and connectors
Most switches OK, only a few fail	Faulty control unit	Perform Hand Control check
Table will not stay in film mode	Faulty switch panel	Perform Hand Control check

Hand Control Check

Every button press on the GE OEC hand control (pn 901571) closes 2 pole switches. The first pole that closes is the security switch and then after a detent is felt the table movement pole is closed. When the security pole is closed, it shorts P8-3 to +12Vdc on P8-6, film mode request table security shorts A21P1-23 to 12Vdc on A21P1-24 is passed on via A21J1-23 to A3A2P4-12 then onto A3A2J2-5. This signal (XCC_SCRTY) is passed onto A3A2J2-5, P12-1, P13-15, J15-1, then to A1A2P4-22. Disconnect J15 inside the backpack, while a table motion button is pressed, measure 12Vdc between J15 pins 1 and 3. Check this signal with all hand control buttons and the film mode request button. If all switches fail, check the interconnecting cables. If only a few switches fail, suspect the control unit. If the table won’t stay in film mode, the table will move with a hand control and the test of lightly holding the film request button down doesn’t cause the “CALL SERVICE –60” error to occur after 6 to 10 seconds, suspect the switch panel.

X-Ray Security

If you have trouble with the X-ray generation controls, troubleshoot as follows:

The x-ray generation buttons have 2 pole switches, the first pole x-ray security cannot be felt when the button is pressed. The second pole, x-ray generation command switch, is closed after a detent is felt. The security pole shorts A21P1-25 to A21P1-31 the x-ray security signal (XRAY_SCRTY) is passed from A21P25 to A3A2P4-13, A3A2J2-6, P12-2, P13-16, J15-2, A1A2J4-9. Disconnect J15 inside the backpack, while an X-ray generation button is pressed, measure 12Vdc between J15 pins 2 and 3. Check this with both X-ray buttons. If a failure of the above test occurs, check back up the cable/connector chain. Refer to sheets 3 and 6 of 2800 Interconnect Diagram 881504 for more information.

Frequency Inverters

As described earlier in this manual, the Frequency Inverters have the following characteristics:

- They control operation of all but one of the Table motors (M6). For this reason, most informed persons call them motor controllers. Although this is an infinitely better name for these devices, the manufacturer and distributor steadfastly refer to them as frequency inverters. That's what's on most of the schematics, and that's what you're likely to see in the service documentation. Sad, but true. Just remember, when you read the term Frequency Inverters, the writer is really talking about motor controllers.
- They receive operating power via Relay K3 in the Backpack. Be sure to review the *Power Distribution* chapter of the service manual. (Sheet 9 of 2800 Interconnect Diagram 00-881504-01 shows Relay K3.)
- They regulate the operation of five of the six motors that impart motion to the Table. Be sure to review the other sections of this manual with emphasis on the block diagrams. The diagrams provide the full theory of operation for each table motion.
- They are all Field Replaceable Units (FRUs). Following installation of a new motor controller, you must check the operating parameters as described in this section. Those instructions are already provided in the *Replacement* chapter of the service manual. However, this document provides certain clarifications and additional information not found in the service manual.

Motor Controller Operation Within the Pausch Table

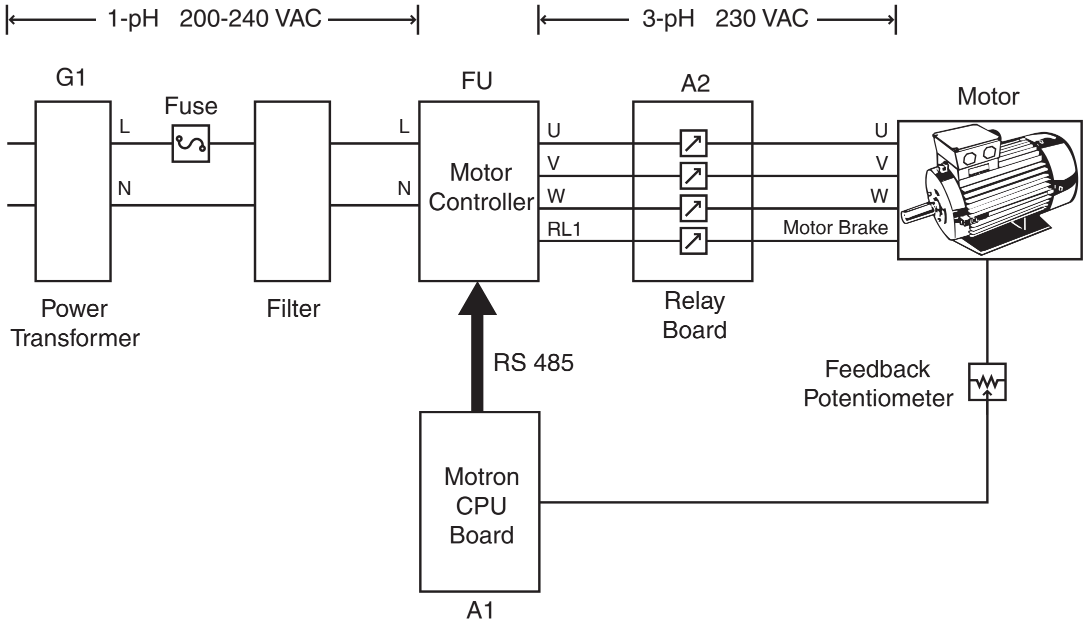
The motor controllers manage table movement by controlling the three-phase power to the motors. The Motron CPU board and motor controllers work together to control motor startup acceleration, low and high speed drive, and stopping deceleration. More specifically, the motor controllers limit the current to the motors, as shown in the block diagram following. The motor controllers also control motor brake application (see *Motor Controller Internal Operation*, in the following section of this Instruction).

The motor controllers change the single-phase power output of the table power supply into three-phase AC for five of the six table motors—click here for information on table lateral motion. Two motor controllers run all five motors. This is accomplished by multiplexing the motor controller outputs through a relay board (also called the Contactor Board A2) to the individual motors. The Motron CPU board controls the relay board to determine which motor the motor controllers energize. (Refer to UroView Schematic 885015 for more information.)

The motor controller-to-motors association is shown in the table below. The diagram that follows next shows a typical motor hookup:

Frequency Inverter Motor Assignments

FU1- Motor Controller / Motors	FU2- Motor Controller / Motors
M1 – Vertical tilt A	M3 – Vertical tilt B
M2 – Image chain	M4 – Tabletop Longitudinal
	M5 – Film Cassette


1-pH 200-240 VAC
3-pH 230 VAC
G1
L
N
Fuse
Power Transformer
Filter
FU
L
N
Motor Controller
U
V
W
RL1
A2
Relay Board
RS 485
Motron CPU Board
A1
Motor
U
V
W
Motor Brake
Feedback Potentiometer

Pausch Table Motor Control Function

Note: It is important to understand the power implications of table motions that require simultaneous operation of both motors. This is explained in the following paragraphs.

To change the vertical elevation or tilt, both motor controllers are needed to run both M1 and M3 together. It is under this condition when both motors are running that one or both of the motor controllers may lock up.

It is under this heavy load that the power system and the facility electrical wiring is under its heaviest load. Should lockup be a problem, do the following:

- Check the voltage on the motor controllers and retap the Table Power Supply transformer T1 to bring the motor controller voltage output up to 230 VAC (see the *Adjustments* section in the *Power Distribution* section of the service manual). Refer to Table Power Supply Wiring Diagram 00-885025-01 for more information.
- Check the facility wire size and verify it is to the current site planning guide rev. D or higher (LR-280006-01). The wire size should be a minimum of 8 AWG copper wire for a 50-foot run. This wire size will increase to 2 AWG copper wire for a 200-foot run.

It may be necessary to add a 5KVA transformer (00-902193-01) to step one phase of the 480 VAC down to 240 VAC to prevent the table from locking up. One advantage of this method is that the power comes from a cleaner source not having to share a power panel with things like the soda machine, fax, laser printer, sterilizer, or others. Another advantage is the large gauge wire used for the x-ray generator enables the Table to have low line impedance to the table tower.

However, after you have looked at these solutions, in the worst power cases, an uninterruptible power supply (UPS) may be needed (00-902192-01).

Fortunately, the other table movements—image chain, tabletop longitudinal, and film cassette—require only one or the other motor controller to operate. These table movements put less demand on the table power system and are less likely to lock up.

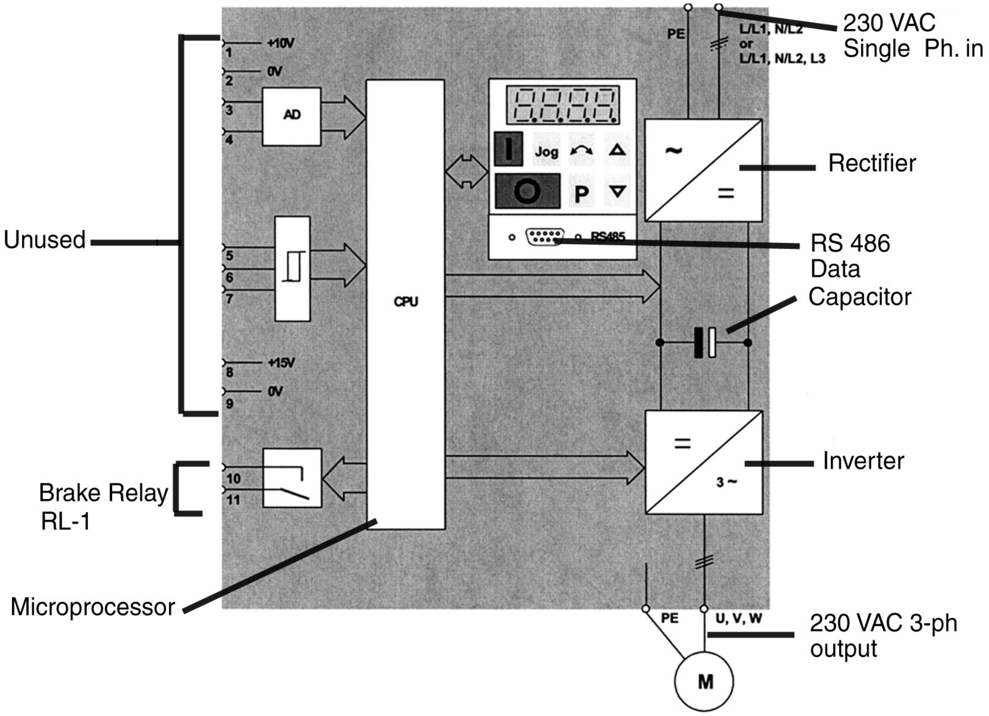
Furthermore, you can use this one-for-one-correspondence to help troubleshoot which motor controller is bad by exercising one motor at a time.

Note: Under Motron CPU board control, the motors are able to run two at a time as discussed above, but not if you use the hand and foot control. For example, when the LOAD button is pressed, both the longitudinal M4 and lateral M6 motors will turn simultaneously.

Motor Controller Internal Operation

Single-phase 230 VAC power incoming to the motor controller (see block diagram on next page) is rectified into DC and stored in a large capacitor. The capacitor stores all of the motor power (over a time span of about 10 msec). The CPU microprocessor controls capacitor output to the inverter, which changes the DC to 3-phase AC to power the motors. Under microprocessor control, the current and frequency of the inverter output determines motor rotational direction and speed. A motor brake is integral to each motor package except for M4. The microprocessor also controls motor brake application via relay RL-1.

All external control of the motor contoller is provided via RS 485 from the Motron CPU PCB.

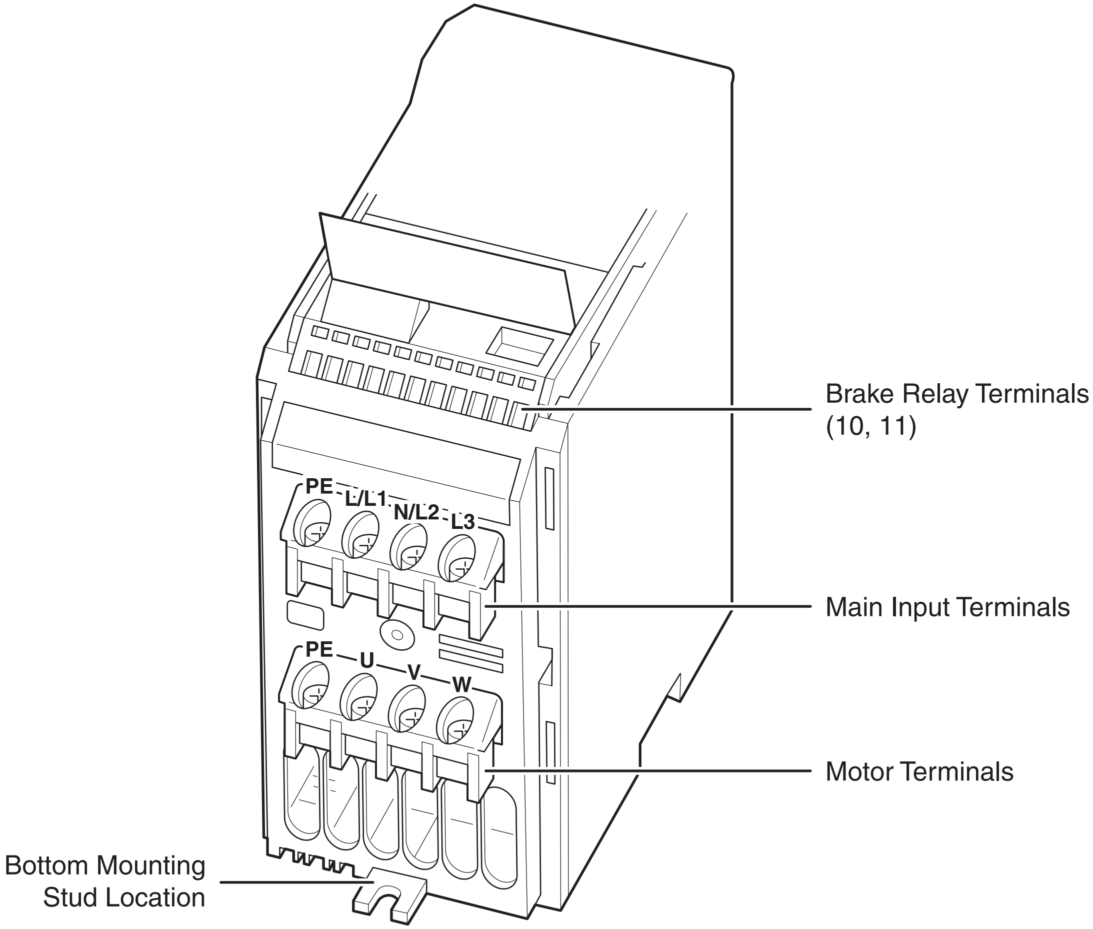

+10V
0V
AD
+15V
0V
1
2
3
4
5
6
7
8
9
10
11
CPU
Jog
P
RS485
PE
L/L1, N/L2
or
L/L1, N/L2, L3
~
=
=
3 ~
PE
U, V, W
M
230 VAC
Single Ph. in
Rectifier
RS 486
Data
Capacitor
Inverter
230 VAC 3-ph
output
Unused
Brake Relay
RL-1
Microprocessor

Motor Controller Internal Block Diagram

Motor Controller Replacement

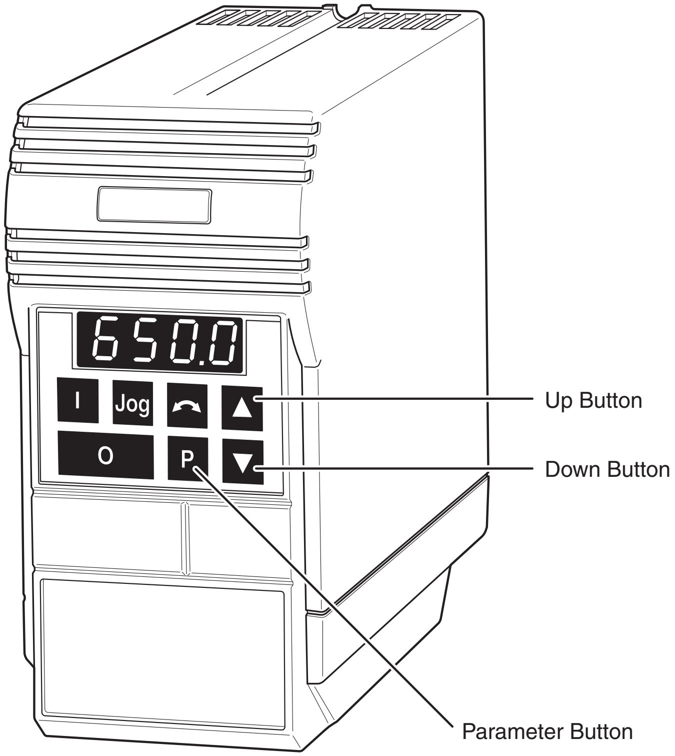
Refer to the picture on the following page while removing and replacing a motor controller.

1. Remove metal enclosure that houses the two motor controllers.
2. Remove the 9-pin D connector (RS 485) from the motot controller front panel.
3. Remove the brake relay wires from the front panel control terminals 10 and 11.
4. Remove the main power AC connections on terminals PE (Ground), L and N.
5. Remove the wires from the motor terminals PE (Ground), U, V, and W.
6. Loosen the bottom nut from the stud.
7. Remove the top nut from the stud and remove the motor controller.
8. Reverse the order of steps 6 through 1 to replace the motor controller.
9. Set the motor controller parameters (see next section).


PE
L/L1
N/L2
L3
PE
U
V
W
Brake Relay Terminals (10, 11)
Main Input Terminals
Motor Terminals
Bottom Mounting Stud Location

Motor Controller Cable and Wiring Locations

Checking and Setting Motor Controller Parameters


650.0
I
Jog
O
P
Up Button
Down Button
Parameter Button

Motor Controller Unit Control Panel

Note: The controls not called out above are not used in the UroView application.

After installing a new motor controller, power up the system and check the required motor controller parameter settings, adjusting as required according to the following tables.

Required Parameter Setting				
Parameter	**Function**	**Description**	**Motor Controller Value**	
			FU1	**FU2**
P009	Parameter Protection Setting	All parameters can be read/set.	3	3
P091	Serial Link Slave Address	This parameter sets a unique address for each motor controller.	0	1
P092	Serial Link Baud Rate	19200 Baud	7	7
P095	USS Compatibility	The inputs are not scaled but represent the actual frequency value.	2	2
P910	Local/Remote Mode	Remote Control	1	1

How to Set Motor Controller Parameters			
Step	**Description**	**Button**	**Display**
1	Press the parameter button.	P	P000
2	Press the UP button until parameter **P009** is displayed.	▲	P009
3	Press **P** to display the current parameter value.	P	0000
4	Press the UP button until the correct value for the parameter **P009** is displayed.	▲	0003
5	Press **P** to lock the setting into memory.	P	P009
6	Continue setting the remaining parameters by repeating steps 2 - 5	▲ P	
7	Press the DOWN button to return to **P000**	▼	P000
8	Press **P** to exit the parameter setting procedure.	P	0.0
9	Reboot the system and check table movements.		

Note: Hold the UP or DOWN button for a few seconds to scroll through the parameters quickly.

Hints and Tips When Setting Parameters

Parameters **P000** to **P009** can always be read or set. Access to all other parameters is controlled by the contents of **P009**. The factory default value is ‘0’, which allows access only to **P000** to **P009**. Changing its value to ‘3’ allows all parameters to be accessed permanently.

If you have problems with the parameter settings and wish to start again, change **P944** to ‘1’. This will perform a reset to the default values.

The value displayed in **P000** is the output frequency of the motor controller. This is the default setting, but altering the value in P001 can change it. For example, changing **P001** to a value of ’5’ will cause the motor controller to display the RPM of the motor in **P000.**

If the display flashes during operation, the drive is registering a warning. Check **P931** for the cause.

Motor Controller Troubleshooting

In the event of a failure, the motor controller switches off and a fault code appears on the display. The last fault that occurred is stored in parameter **P140**, the preceding faults in **P141-P143**. See the following table for common fault codes.

Fault Code	Cause	Corrective Action
F002	Over Current	Check motor lead and motor for short circuits and earth ground faults. Check the stator resistance of the motor. Check whether the motor is obstructed.
F003	Over Load	Check whether the motor is obstructed.
F005	Motor Controller Over Temperature (internal heatsink sensor)	Check that the ambient temperature is not too high. Check that the air inlet and outlet are not blocked. Check that the integral fan is working.
F008	USS Protocol timeout	Check the serial interface. Check the setting of P091 and P902.
F011	Internal Interface Fault	Switch power off and reboot table.
F013	Program Fault	Switch power off and reboot table.
F101	Internal Interface Fault	Switch power off and reboot table.
F105	Motor Controller Over Temperature (internal sensor)	Check that the ambient temperature is not too high. Check that the air inlet and outlet are not blocked. Check that the integral fan is working.
F231	Output Current Measurement Imbalance	Check motor lead and motor for short circuits and earth ground faults. Check the stator resistance of the motor. Check whether the motor is obstructed.

Motor Brake Troubleshooting

Motor FU1 (FU0)

The following is an indication of a stuck relay for the brakes in the motor controller FU1 or no communication with the Motron CPU board at boot up.

Note: In the error messages, some references to the motor controllers are FU0 and FU1 and others are FU1 and FU2. You should use the FU1 and FU2 convention.

Error	**Displayed message**	**Logged Table Message**	**Code**	**Logged**	**Displayed**
Relay FU0 Frequency Problem – Motor Operating In Error	CALL SERVICE -67 (line2)	TBL FL0 FREQUENCY PROBLEM	67	√	√

To troubleshoot the motor brakes, follow these steps:

1. **Check the motor controller FU1 brake relay:**

   With the power off, use an ohmmeter on the relay board on connector X6 pins 8 and 9. This should be a normally-open relay contact. The motor controller closes the relay contact when it wants to release the brakes before driving a motor. A short with the power off indicates a stuck relay inside of the motor controller. Replace the motor controller FU1. Refer to sheet 2 of Relay PCB Schematic 884219 for more information. You can also find helpful information in Table Block Diagram 885015.

2. **Check the CPU connector X9 on the relay board:**

   The X9 connector pin 12 on the relay board will indicate the status of the FU1 motor controller brake relay. When the brake relay is inactive, pin 12 should not have 24-VDC on it. This is an indication that the brake relay is stuck closed or a short on the relay board. Pin 12 will have 24-VDC when the brake relay is activated. The brake relay is active when a motor with a brake is moving in this case motor M2 or M1. Replace Relay board if not working. Refer to sheet 1 of Relay PCB Schematic 884219 for additional information.

3. **Check the CPU board connector X5:**

   Verify that the signal is coming onto the CPU board. Check connector X5 pin 12. Use the X1 connector pin 4 as the 24V ground reference. Pin 12 will have 24-VDC when the brake relay is activated. The brake relay is active when a motor with a brake is moving—in this case motor M2 or M1. Replace or repair cable if not working. (Refer to sheet 3 of Motron CPU PCB schematic 884216-01 to see connector X5.)

4. **Check the CPU board opto-isolator:**

   The CPU board connects by X5 connector to the Relay board. The FU1 brake relay status line is opto-isolated from the CPU. Check the opto-isolator IC20 pin 14. Pin 14 will be near digital ground (150 mV) when activated (brake relay closed) or +5VDC when not activated. Use a voltmeter with pin 2 or heat tab on IC12 the +5 volt regulator (7805) on the CPU board as ground. Replace CPU board if not working. (Refer to sheet 3 of Motron CPU PCB schematic 884216-01 to IC20.)

5. **Use Motron tool to capture the boot sequence:**

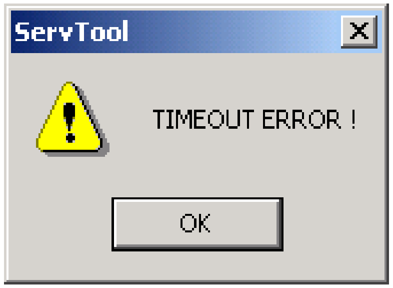
   A. Turn off the system power.

   B. Remove the cover from the top of the table tower; connect your computer to the serial port.

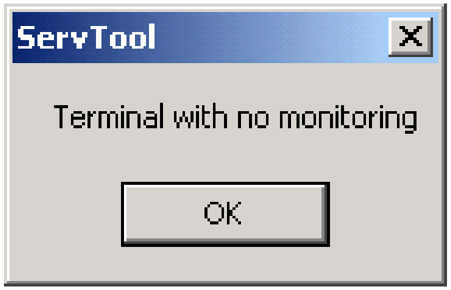
   C. Open up the utility suite software and select the Motron tool option.

   D. Open up the oec_new.hpp file.

   E. Select the “Monitor” button. After communication times out the following messages will come up.



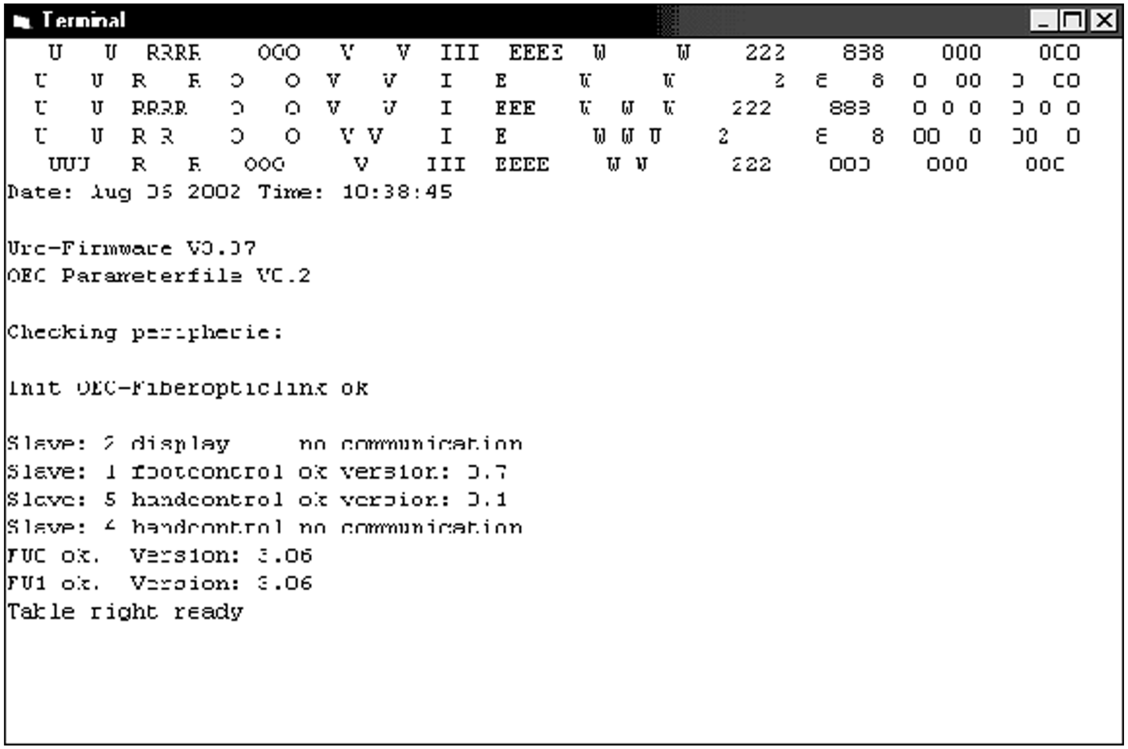
TIMEOUT ERROR !



Terminal with no monitoring

   F. Click OK on both. This will open up the Motron Bootup terminal window similar to the example on the next page, but blank.

   G. Turn on the system power.



```
   U   U  RRRR    OOO   V   V  III  EEEE  W     W    222    888    000    000
  U   U  R   R  O   O  V   V   I   E     W     W       2  8   8  0 00   0 00
  U   U  RRRR   O   O  V   V   I   EEE   W  W  W    222    888   0 0 0  0 0 0
  U   U  R R    O   O   V V    I   E      W W W    2      8   8  00  0  00  0
   UUU   R   R   OOO     V    III  EEEE    W W      222    888    000    000
Date: Aug 05 2002 Time: 10:38:45

Urc-Firmware V0.07
OEC Parameterfile V0.2

Checking peripherie:

Init OEC-Fiberopticlink ok

Slave: 2 display      no communication
Slave: 1 footcontrol ok version: 0.7
Slave: 5 handcontrol ok version: 0.1
Slave: 4 handcontrol no communication
FU0 ok.  Version: 3.06
FU1 ok.  Version: 3.06
Table right ready
```

Verify these values appear when system boots on Motron terminal

Motron Bootup Terminal Window

As the system powers up, the window will display some power on diagnostics, then the software version. The next thing to be displayed will be “FU0 OK” and “FU1 OK” messages showing that the units have power up and are communicating with the CPU board.

If these messages do not appear, there could be an RS485 communication problem with the CPU board and or the motor controllers FU1 and FU2.

H. The motor controllers are wired in a daisy chain. Disconnect one and try again to see if one will establish a communication link.

I. Try the other motor controller.

6. **Check the X6 connector on the CPU board.**

   Measure the voltage between pins 1 and 4 on the X6 connector on the CPU board with pin 4 as the ground reference. It should measure 5.0 VDC. Check pins 2 and 3 for a differential signal to the motor controllers during a motor movement. These are the RS485 communication pins to the motor controllers. (Refer to sheet 12 of Motron CPU PCB schematic 884216-01 for more information.)

Motor FU2 (FU1)

The following is an indication of a stuck relay for the brakes in the motor controller FU1 or no communication with the Motron CPU board at boot up.

Note: Some references to the motor controllers are FU0 and FU1 and others are FU1 and FU2. You should use the FU1 and FU2 convention.

Error	**Displayed message**	**Logged Table Message**	**Code**	**Logged**	**Displayed**
Relay FU1 Frequency Problem – Motor Operating In Error	CALL SERVICE -50 (line2)	TBL FU1 FREQUENCY PROBLEM	50	√	√

To troubleshoot the motor brakes, follow these steps:

1. **Check the motor controller FU2 brake relay:**

   With the power off, use an ohmmeter on the relay board on connector X7 pins 8 and 9. This should be normally open relay contact. The motor controller closes the relay contact when it wants to release the brakes before driving a motor. A short with the power off indicates a stuck relay inside of the motor controller. Replace the motor controller FU2. (Refer to sheet 2 of Relay PCB schematic 884219-01 for more information.) (Refer also to Table Block Diagram 885015)

2. **Check the CPU connector X9 on the relay board:**

   The X9 connector pin 14 on the relay board indicates the status of the FU2 motor controller brake relay. When the brake relay is inactive, pin 14 should not have 24-VDC on it. This is an indication that the brake relay is stuck closed or a short on the relay board. Pin 14 will have 24-VDC when the brake relay is activated. The brake relay is active when a motor with a brake is moving in this case motor M1 or M2. Replace Relay board if not working. (Refer to sheet 1 of Relay PCB schematic 884219-01 for more information.)

3. **Check the CPU board connector X5:**

   Verify that the signal is coming onto the CPU board. Check connector X5 pin 14. Use the X1 connector pin 4 as the 24V ground reference. Pin 14 will have 24-VDC when the brake relay is activated. The brake relay is active when a motor with a brake is moving—in this case motor M1 or M2. Replace or repair cable if not working. (Refer to sheet 3 of Motron CPU PCB schematic 884216-01 for more information.)

4. **Check the CPU board optoisolator:**

   The CPU board connects by X5 connector to the Relay board. The FU2 brake relay status line is opto-isolated from the CPU. Check the optoisolator IC20 pin 12. Pin 12 will be near digital ground (150 mV) when activated (brake relay closed) or +5VDC when not activated. Use a voltmeter with pin 2 or heat tab on IC12, the +5 volt regulator (7805) on the CPU board as ground. Replace CPU board if not working. (Refer to sheet 3 of Motron CPU PCB schematic 884216-01 for more information.)

5. **Use Motron tool to capture the boot sequence:**

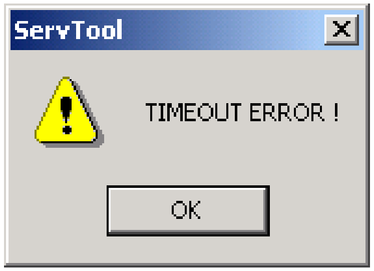
   A. Turn off the system power.

   B. Remove the cover from the top of the table tower; connect your computer to the serial port, and enter service mode.

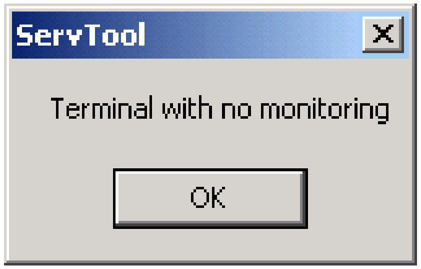
   C. Open up the utility suite software and select the Motron tool option.

   D. Open up the oec_new.hpp file.

   E. Select the “Monitor” button. After communication times out the following messages will come up:



TIMEOUT ERROR !



Terminal with no monitoring

F. Click OK on both. This will open up the Motron Bootup terminal window, similar to the example on the next page, but blank.

G. Turn on the system power:

   As the system powers up the window will display some power on diagnostics, then the software version. The next thing to be displayed will be “FU0 OK” and “FU1 OK” messages showing that the units have power up and are communicating with the CPU board.

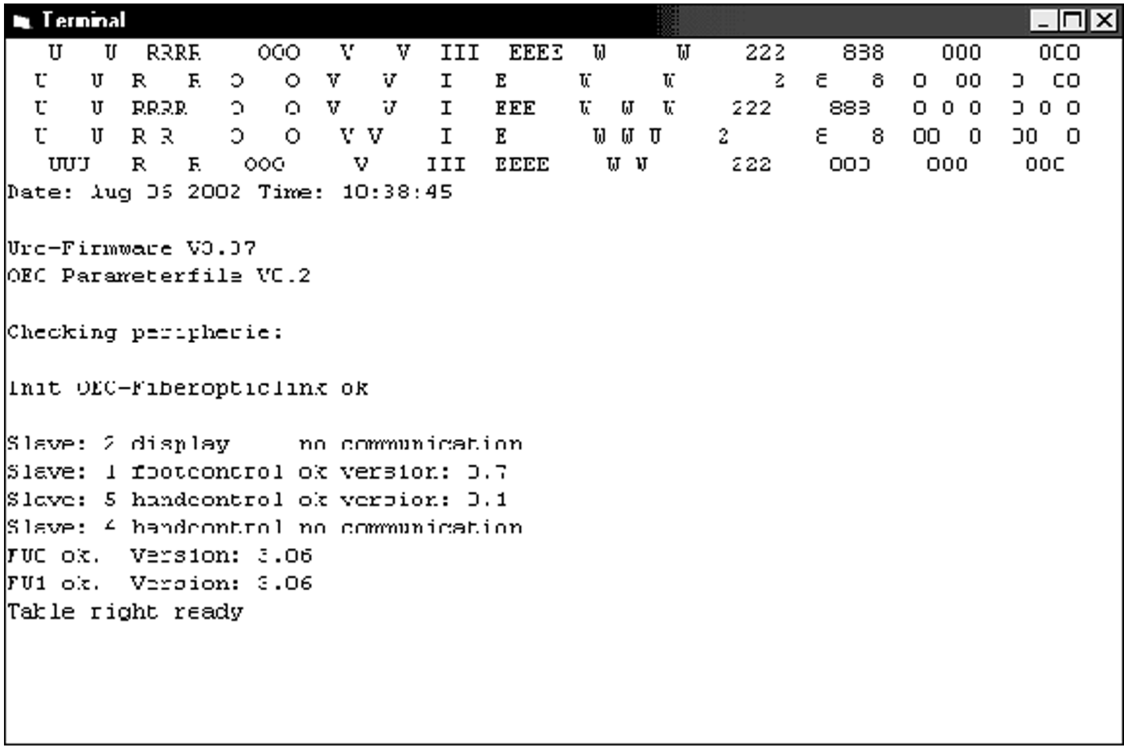
   If these messages do not appear, there could be an RS485 communication problem with the CPU board, or the motor controllers FU1 and FU2.

H. The motor controllers are wired in a daisy chain. Disconnect one and try again to see if one will establish a communication link.

I. Try the other motor controller.

6. Check the X6 connector on the CPU board.

Measure the voltage between pins 1 and 4 on the X6 connector on the CPU board with pin 4 as the ground reference. It should measure 5.0 VDC. Check pins 2 and 3 for a differential signal to the motor controllers during a motor movement. These are the RS485 communication pins to the motor controllers. (Refer to sheet 12 of Motron CPU PCB schematic 884216-01 for more information.)



```
   U   U  RRRR    OOO   V   V  III  EEEE  W     W    222    888    000    000
  U   U  R   R  O   O  V   V   I   E     W     W       2  8   8  0  00  0  00
  U   U  RRRR   O   O  V   V   I   EEE   W  W  W    222    888   0 0 0  0 0 0
  U   U  R R    O   O   V V    I   E      W W W    2      8   8  00  0  00  0
   UUU   R   R   OOO     V    III  EEEE    W W      222    888    000    000
Date: Aug 05 2002 Time: 10:38:45

Urc-Firmware V0.07
OEC Parameterfile V0.2

Checking peripherie:

Init OEC-Fiberopticlink ok

Slave: 2 display     no communication
Slave: 1 footcontrol ok version: 0.7
Slave: 5 handcontrol ok version: 0.1
Slave: 4 handcontrol no communication
FU0 ok.  Version: 3.06
FU1 ok.  Version: 3.06
Table right ready
```

Verify these values appear when system boots on Motron terminal

Motron Bootup Terminal Window

Pausch Tool

The Pausch tool is a software program that allows users to intercept and translate fiber optic signals (telegrams) from the Table CPU motherboard to the TGI board. These fiber optic signals are conducted over a one-way communication path. A separate communication path conducts other types of signals traveling in the opposite direction, from the TGI board to the hand control connector on the Table CPU board.

The Pausch tool software has the ability to log the telegrams to a file with the time lag intact. The files can be selected later as the input to the Pausch tool program. The Pausch tool also has the ability to translate the log file to a text file that can be imported into a spreadsheet or text program. Thus the user can easily search through the file for specific failures or e-mail it to Salt Lake for review. Each telegram is received, displayed in the hex encoded telegram window, translated to text or a decimal number, and displayed in its appropriate window.

The Pausch tool deals only with the following two types of information:

- Table potentiometer and status information (6 motor, pot and software stops)
- Table status, warning and error information

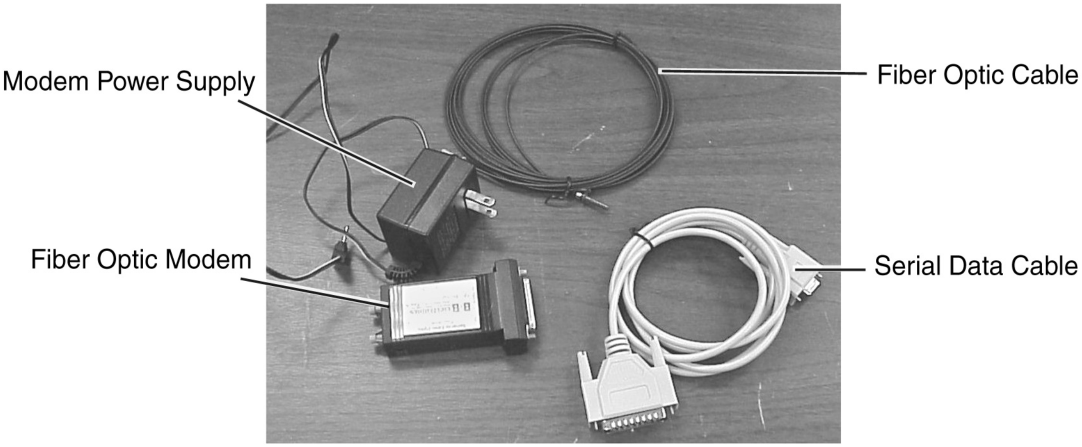
Note: *The following paragraphs show you how to connect and use the Pausch tool. However, it does not provide specific troubleshooting instructions.*

Getting Started

A fiber optic translator kit (p/n 884422) is needed to use this software.

The function of the fiber optic translator kit is to receive the fiber optic telegrams and retransmit them on to the TGI board so that the 2800 continues to function normally with no table communication errors. The kit contains the following components:

1. A fiber optic modem
2. A power supply for the modem
3. A serial data cable
4. A fiber optic cable



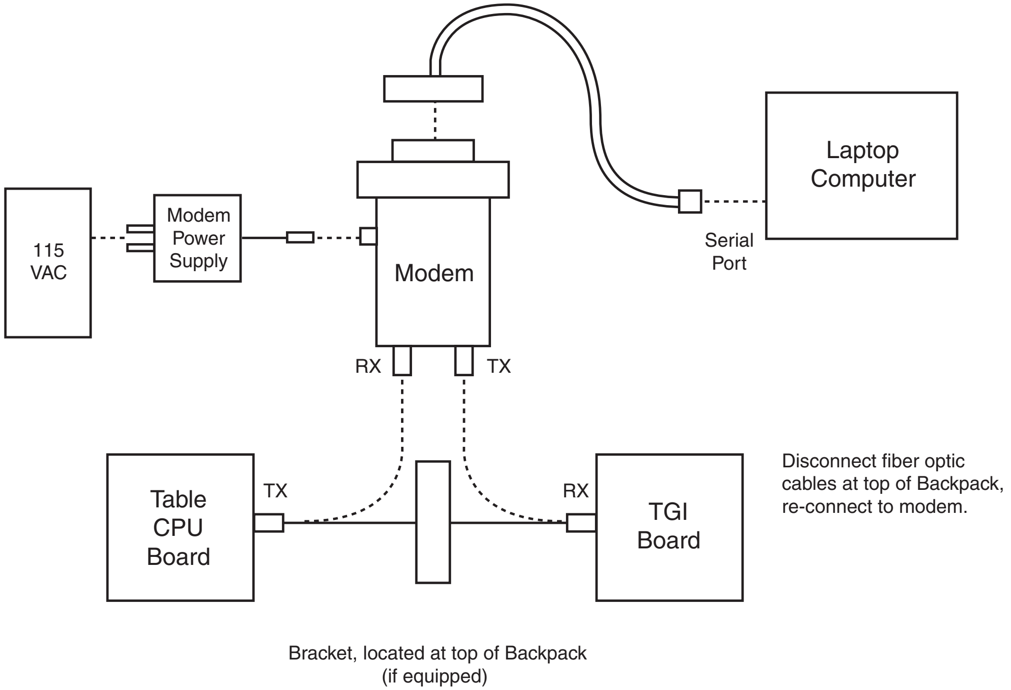
Contents of the Fiber Optic Translator Kit

The translator receives the telegrams, re-transmits them to the Table Generator Interface (TGI), translates them into RS232 data, and sends them via serial data cable to a serial port on your laptop computer. The Pausch tool program resides on the Utility Suite CD and will display the fiber optic communcations in a readable form.

Install the Fiber Optic Translator Kit and Connect the Laptop Computer

CAUTION: *While installing the translator,do not flex the fiber optic cables tighter than a 2-inch radius bend. Otherwise, you will degrade or break the cable.*

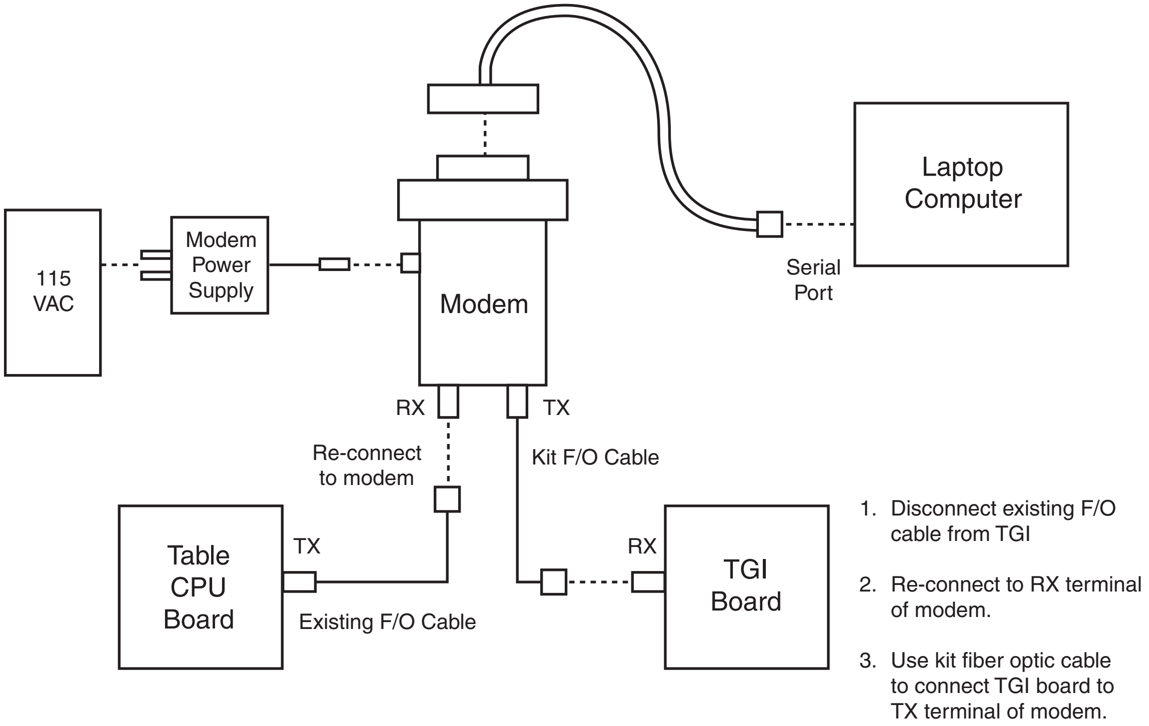
1. If your system is equipped with the external fiber optic interface bracket located at the top of the backpack, disconnect both fiber optic cables from the bracket connector. Connect the blue-colored cable connector to the blue receptacle on the modem. Connect the gray-colored cable connector to the gray receptacle on the modem.


Laptop
Computer
Serial
Port
115
VAC
Modem
Power
Supply
Modem
RX
TX
Table
CPU
Board
TX
RX
TGI
Board
Bracket, located at top of Backpack
(if equipped)

Disconnect fiber optic cables at top of Backpack, re-connect to modem.

Installation of the Fiber Optic Translator Kit (with external F/O interface)

2. If your system is not equipped as above, disconnect the existing fiber optic cable at the TGI board. Reconnect it to the RX terminal of the modem. Using the kit fiber optic cable, connect the TGI board to the TX terminal of the modem.
3. Connect the modem, modem power supply, and serial interface cable as shown in the applicable diagram.

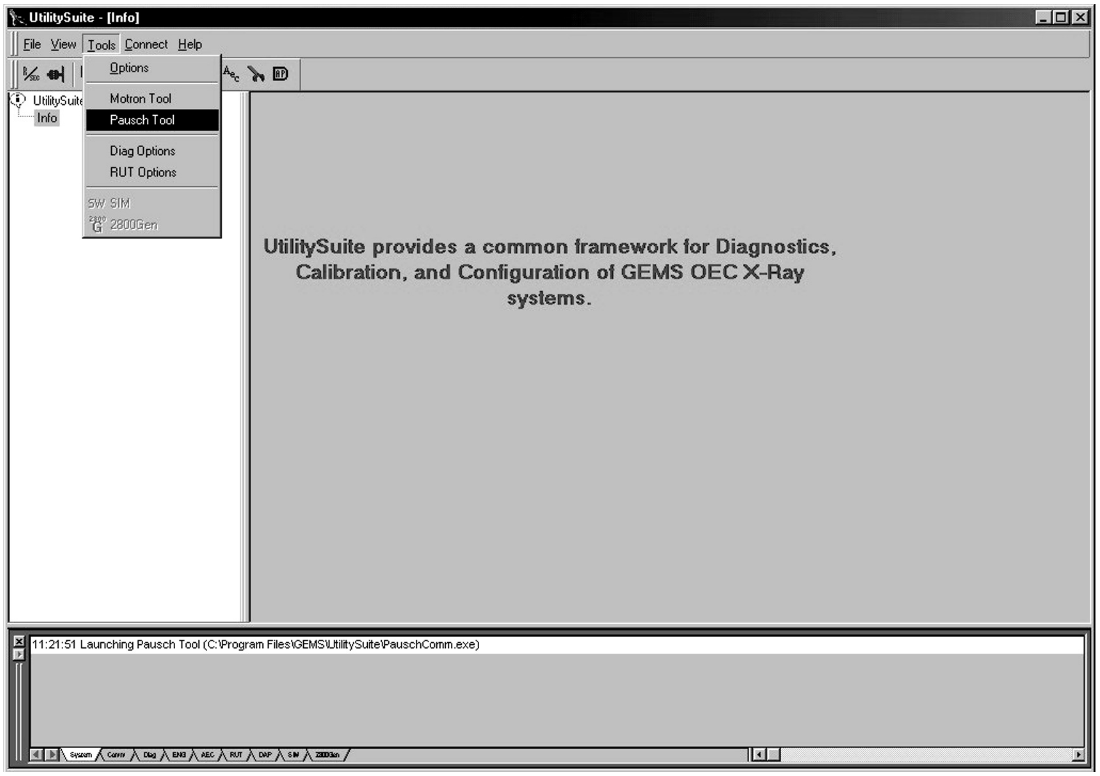

115
VAC
Modem
Power
Supply
Modem
Laptop
Computer
Serial
Port
RX
TX
Re-connect
to modem
Kit F/O Cable
Table
CPU
Board
TX
Existing F/O Cable
RX
TGI
Board
1. Disconnect existing F/O cable from TGI
2. Re-connect to RX terminal of modem.
3. Use kit fiber optic cable to connect TGI board to TX terminal of modem.

If not equipped with bracket at top of Backpack

Installation of the Fiber Optic Translator Kit (without external F/O interface)

Open the Pausch Tool

To open the Pausch tool, start the current Utility Suite and select “Tools”. From the Tools pulldown menu, click Pausch Tool. (see the following picture).


UtilitySuite - [Info]
File
View
Tools
Connect
Help
Options
Motron Tool
Pausch Tool
Diag Options
RUT Options
SW SIM
2800Gen
UtilitySuite
Info
System
Comm
Diag
ENG
AEC
RUT
DAP
SIM
2800Gen

UtilitySuite provides a common framework for Diagnostics, Calibration, and Configuration of GEMS OEC X-Ray systems.

```
11:21:51 Launching Pausch Tool (C:\Program Files\GEMS\UtilitySuite\PauschComm.exe)
```

Open the Pausch Tool from Inside Utility Suite

The Pausch Communication Monitor screen appears (see next page). This screen provides all the controls and data displays needed to display all table motion and potentiometer status telegrams. The screen is divided into the following windows or displays:

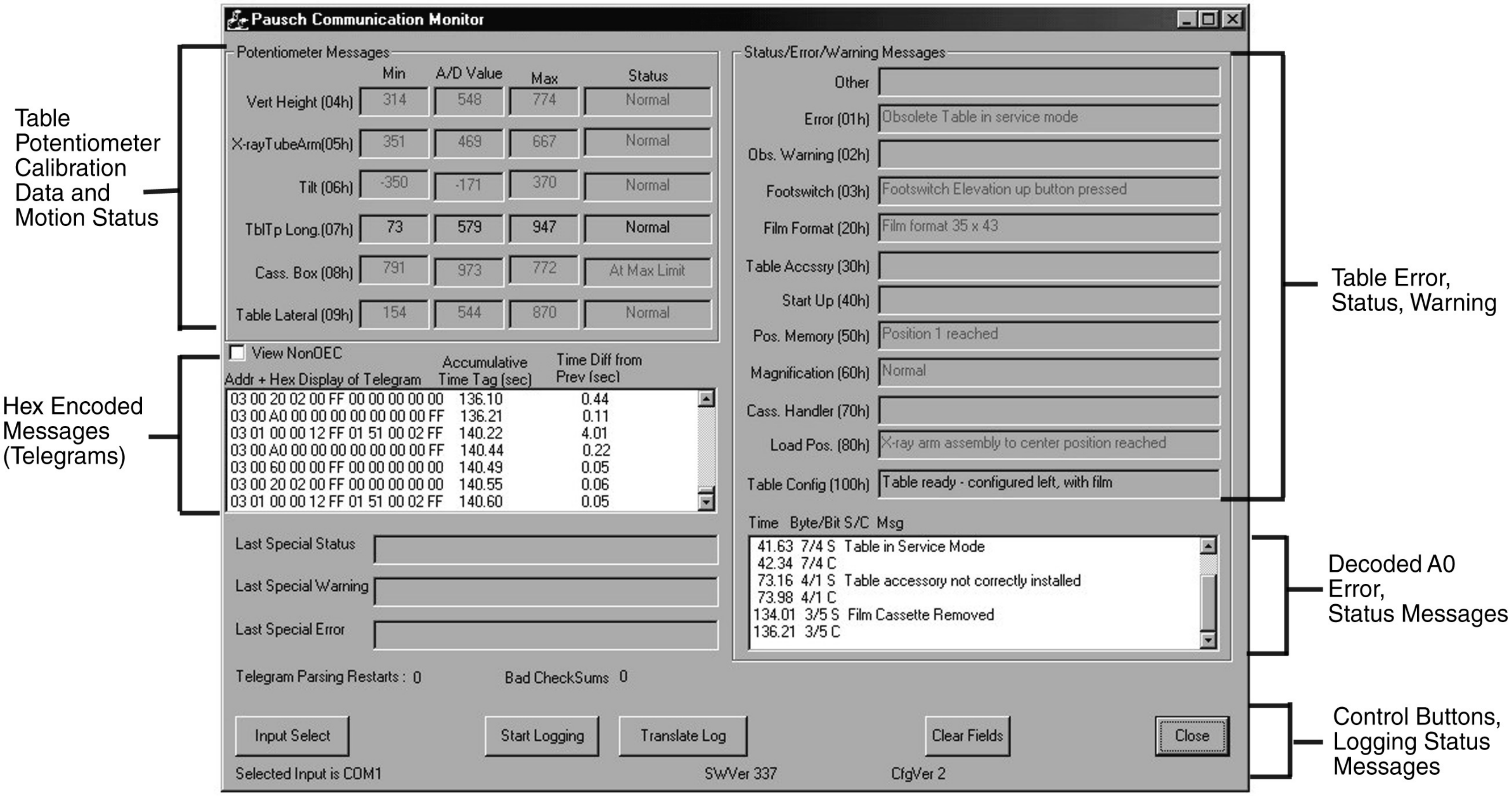
1. Table potentiometer calibration and motion status
2. Hex encoded messages (telegrams)
3. Table error, status, and warning essages
4. Decoded AO error and status messages
5. Control buttons and logging status messages

A Tour of the Pausch Communication Monitor Screen

The following discussions explain the purpose and function of the main information windows of the Pausch Communication Monitor screen.

Potentiometer Messages

The Potentiometer Messages window is composed of 4 columns and 6 rows (see Potentiometer Messages Window, below). Each row is a different table movement. The columns indicate the motion calibrated Min value, the current A/D Value of the pot for that motion, the calibrated Max value, and the status indicating if the motion is in either the max, min or center software limit. A normal status means that the motion is in none of those states.


Pausch Communication Monitor
Table Potentiometer Calibration Data and Motion Status
Hex Encoded Messages (Telegrams)
Table Error, Status, Warning
Decoded A0 Error, Status Messages
Control Buttons, Logging Status Messages
☐ View NonOEC
Input Select
Start Logging
Translate Log
Clear Fields
Close

Potentiometer Messages

	Min	A/D Value	Max	Status
Vert Height (04h)	314	548	774	Normal
X-rayTubeArm(05h)	351	469	667	Normal
Tilt (06h)	-350	-171	370	Normal
TblTp Long.(07h)	73	579	947	Normal
Cass. Box (08h)	791	973	772	At Max Limit
Table Lateral (09h)	154	544	870	Normal

Addr + Hex Display of Telegram	Accumulative Time Tag (sec)	Time Diff from Prev (sec)
03 00 20 02 00 FF 00 00 00 00 00	136.10	0.44
03 00 A0 00 00 00 00 00 00 00 FF	136.21	0.11
03 01 00 00 12 FF 01 51 00 02 FF	140.22	4.01
03 00 A0 00 00 00 00 00 00 00 FF	140.44	0.22
03 00 60 00 00 FF 00 00 00 00 00	140.49	0.05
03 00 20 02 00 FF 00 00 00 00 00	140.55	0.06
03 01 00 00 12 FF 01 51 00 02 FF	140.60	0.05

Last Special Status

Last Special Warning

Last Special Error

Telegram Parsing Restarts : 0

Bad CheckSums 0

Status/Error/Warning Messages

Other	
Error (01h)	Obsolete Table in service mode
Obs. Warning (02h)	
Footswitch (03h)	Footswitch Elevation up button pressed
Film Format (20h)	Film format 35 x 43
Table Accssry (30h)	
Start Up (40h)	
Pos. Memory (50h)	Position 1 reached
Magnification (60h)	Normal
Cass. Handler (70h)	
Load Pos. (80h)	X-ray arm assembly to center position reached
Table Config (100h)	Table ready - configured left, with film

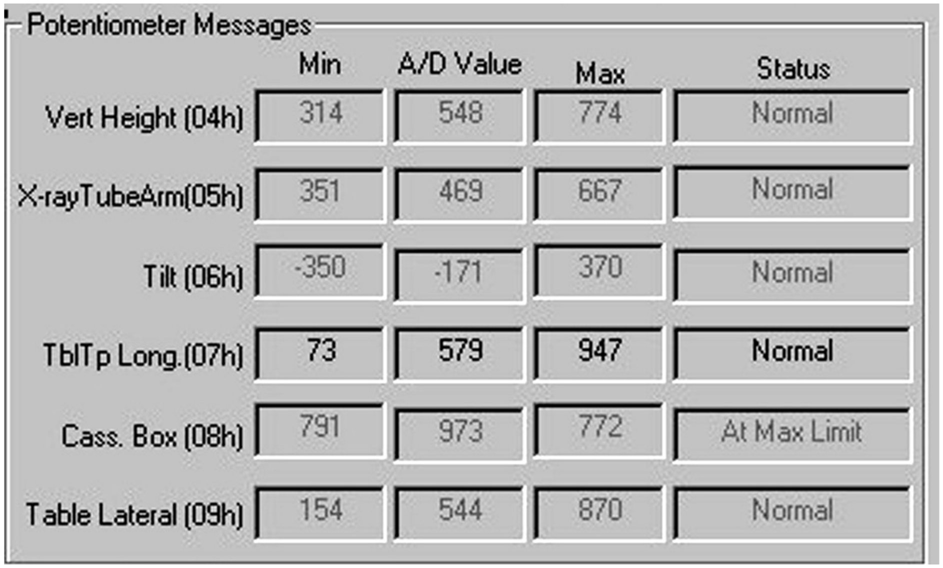
```
Time   Byte/Bit S/C  Msg
 41.63  7/4 S  Table in Service Mode
 42.34  7/4 C
 73.16  4/1 S  Table accessory not correctly installed
 73.98  4/1 C
134.01  3/5 S  Film Cassette Removed
136.21  3/5 C
```

Selected Input is COM1

SWVer 337

CfgVer 2

Pausch Communication Monitor Screen

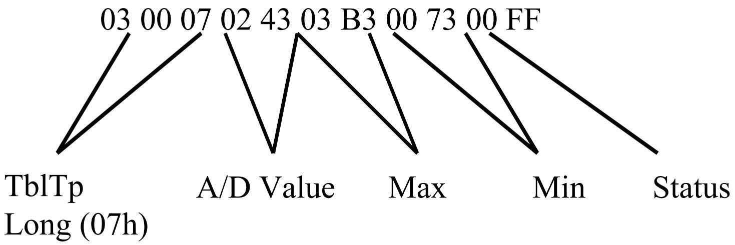


Potentiometer Messages

	Min	A/D Value	Max	Status
Vert Height (04h)	314	548	774	Normal
X-rayTubeArm(05h)	351	469	667	Normal
Tilt (06h)	-350	-171	370	Normal
TblTp Long.(07h)	73	579	947	Normal
Cass. Box (08h)	791	973	772	At Max Limit
Table Lateral (09h)	154	544	870	Normal

Potentiometer Messages Window

In the following diagram, a telegram of 03 00 07 02 43 03 B3 00 73 00 FF is for the longitudinal tabletop motion TblTp Long. (.07h)

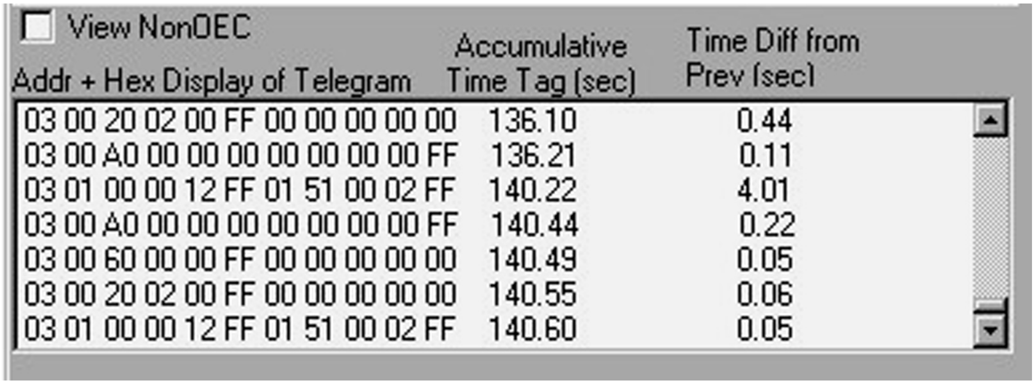


Example of a Potentiometer Message for Longitudinal Tabletop Motion

Hex Encoded Telegram Messages

The Hex encoded telegrams are displayed as they are with no filtering in the window to the lower left side of the Pausch Communications Monitor screen (see next picture). Included in this window are 2 columns which are not sent from the Table CPU board:

- Accumulative time Tag (sec): the time lag from the time you opened the Pausch tool software.
- Time Diff from Prev (sec): the time delay from the previous telegram.



☐ View NonOEC

Addr + Hex Display of Telegram	Accumulative Time Tag (sec)	Time Diff from Prev (sec)
03 00 20 02 00 FF 00 00 00 00 00	136.10	0.44
03 00 A0 00 00 00 00 00 00 00 FF	136.21	0.11
03 01 00 00 12 FF 01 51 00 02 FF	140.22	4.01
03 00 A0 00 00 00 00 00 00 00 FF	140.44	0.22
03 00 60 00 00 FF 00 00 00 00 00	140.49	0.05
03 00 20 02 00 FF 00 00 00 00 00	140.55	0.06
03 01 00 00 12 FF 01 51 00 02 FF	140.60	0.05

Hex Encoded Telegrams

The following table provides a brief explanation of the hex encoded telegrams. However, an in depth discussion is not needed because the Pausch Communication Monitor software will take care of the translating. It will also put the data that is transmitted into its appropriate window. For a more detailed explanation of this communication protocol go to document 881824 pages 12 through 19.

Breakdown of Hex Encoded Telegram

Byte #0	1	2	3	4	5	6	7	8	9	10	Accum. Time Tag (sec)	Time Diff. From Prev
03	00	20	02	00	FF	00	00	00	00	00	136.10	0.44
03	00	A0	00	00	00	00	00	00	00	FF	136.21	0.11
03	01	00	00	12	FF	01	51	00	02	FF	140.22	4.01
03	00	A0	00	00	00	00	00	00	00	FF	140.44	0.22

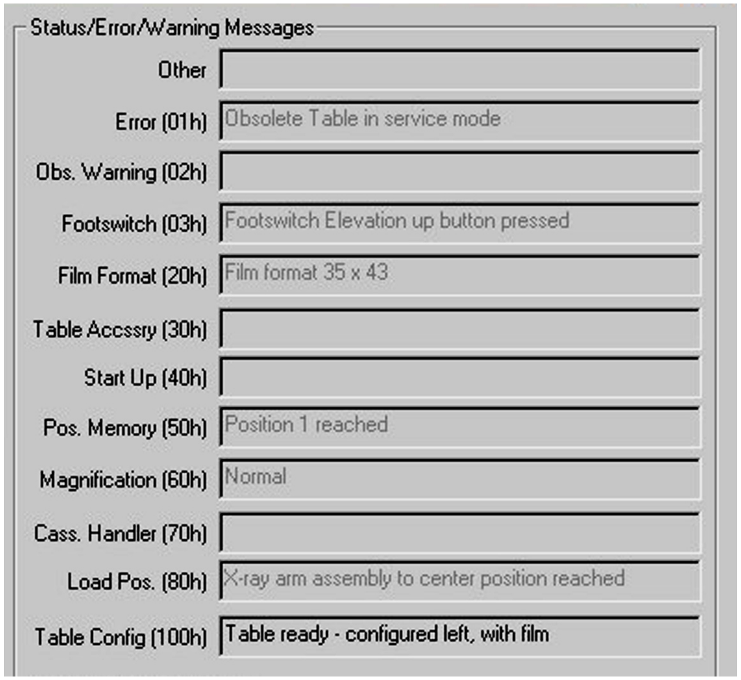
Byte 0 is the address for the control unit with which the Table CPU PCB is communicating. If you want to see all the communications that are being sent out, click on the View NonOEC check box.

Bytes 1 to 10 are the hex encoded telegrams. Look in the window to see where the data should be showing up. For example, if there is a telegram of “03 **00 A0** 00 00 00 00 00 00 00 FF”, **00 A0** data will show up in the window at the lower right hand side of the Pausch Communication Monitor screen.   A telegram of 03 **01 00** 00 00 12 FF 01 51 00 02 FF will show up in the Table Config. (**100**h) window as text, indicating what the Table CPU board is sending—in this case Table ready—configured left, with film (see illustration below).

Status, Error, and Warning Messages

All other status, error, and warning messages. For example, a telegram of “03 00 60 00 00 FF 00 00 00 00 00” indicates in the Magnification window that the magnification mode is normal.

A telegram of “03 00 20 02 00 FF 00 00 00 00 00” indicates in the Film Format window that the Film Format 35x43 is selected.



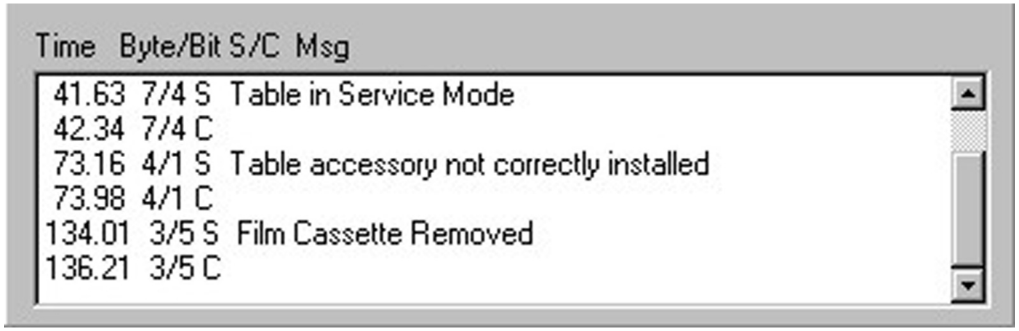
Status/Error/Warning Messages

Other	
Error (01h)	Obsolete Table in service mode
Obs. Warning (02h)	
Footswitch (03h)	Footswitch Elevation up button pressed
Film Format (20h)	Film format 35 x 43
Table Accssry (30h)	
Start Up (40h)	
Pos. Memory (50h)	Position 1 reached
Magnification (60h)	Normal
Cass. Handler (70h)	
Load Pos. (80h)	X-ray arm assembly to center position reached
Table Config (100h)	Table ready - configured left, with film

Status, Error, and Warning Messages Window

Decoded Error A0 and Status Messages

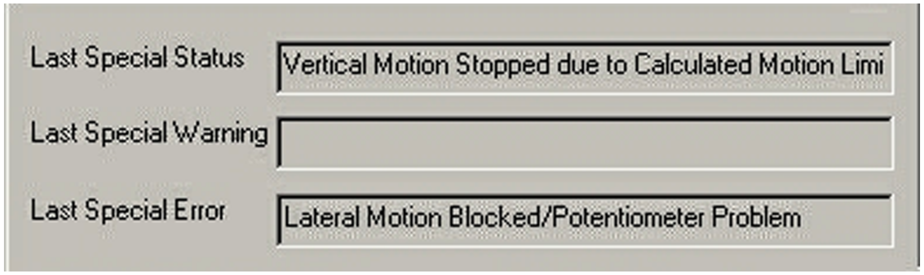
In this window there are three columns. The first column “Time” is the time stamp that the telegram was given in the Hex encoded telegram window. The second column “Byte/Bit S/C” tells you which byte and bit was either set or cleared. For example, line 41.63 below indicates that byte 7 bit 4 was set. Line 42.34 indicates that that same byte/bit was cleared. In column three is the text translation of what that status/error means.



```
Time   Byte/Bit S/C  Msg
 41.63  7/4 S  Table in Service Mode
 42.34  7/4 C
 73.16  4/1 S  Table accessory not correctly installed
 73.98  4/1 C
134.01  3/5 S  Film Cassette Removed
136.21  3/5 C
```

Decoded Error A0 and Status Messages Window

To the left of this window are three displays for messages that are called Last Special Status, Last Special Warning, and Last Special Error (see next picture). These messages will also have appeared in the Decoded Error A0 and Status Messages window, along with any other types of message. However, for certain messages, it is desirable to “capture” and hold them after the others have scrolled past or new telegrams are input. A Last Special message will remain on its display until the indicated condition changes, or you clear the screen.



Last Special Status Vertical Motion Stopped due to Calculated Motion Limi

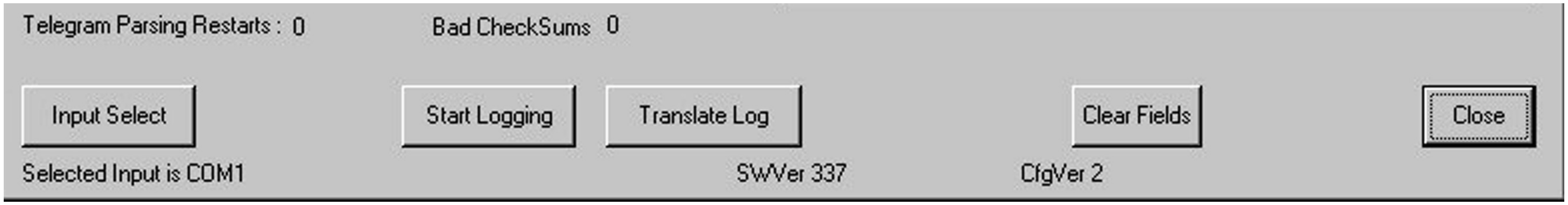
Last Special Warning

Last Special Error Lateral Motion Blocked/Potentiometer Problem

Last Special Messages

Control Buttons and Logging Status Indicators

Along the bottom part of the Pausch Communication Monitor screen are the buttons that let you select program inputs, log data, select program input, log data, process it, clear it from the display, and shut down the Pausch tool. This section of the screen also displays status messages that indicate the progress of your current session.



Telegram Parsing Restarts : 0

Bad CheckSums 0

Selected Input is COM1

SWVer 337

CfgVer 2

Control Buttons

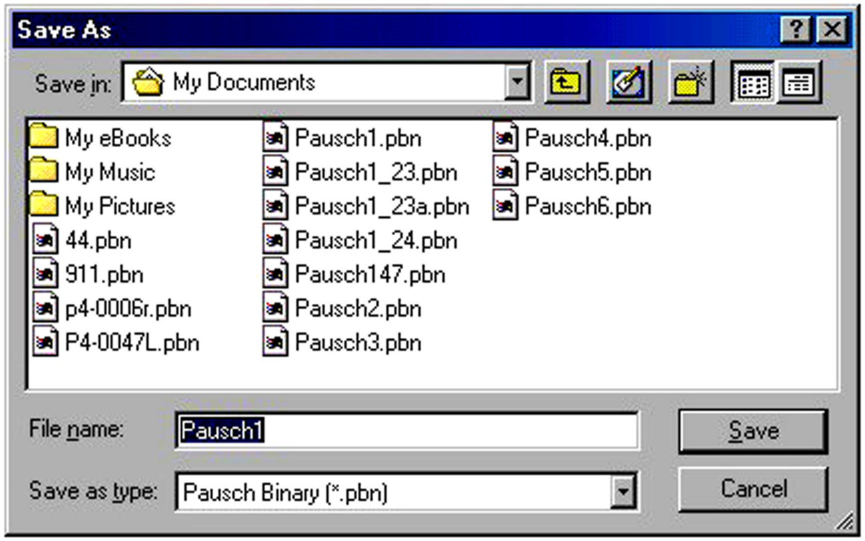
- Telegram Parsing Restarts: a message box that tells you if you are having problems with the fiber optic transmissions. Possible causes of these errors are a bad fiber optic cable or the transmitter on the Table CPU PCB. For a table having intermittent table communication errors this message could help troubleshoot the problem. Trouble is also indicated if the values are visibly incrementing.

- **Bad CheckSums:** will also indicate that you are having problems with fiber optic transmissions, as previously described.
- **Input Select:** a button which lets you select data on a com port or in a file previously logged
- **Start Logging**: moves the data from a selected com port into a file that you name
- **Translate Log**: converts the hex encoded data to a text file
- **Clear Fields**: clears all data displayed in the Pausch Communication Monitor screen
- **Close**: shuts down the Pausch tool
- **Selected Input is COM 1**: a message box that tells you what computer input or file you are inputting into this program. The program defaults to COM 1.
- **SWVer 337**: the version of software the table is running
- **CigVer 2**: the revision of configuration file (*.hpp) on the table

Using the Pausch Communication Monitor Screen

Start Logging

The Start Logging button brings up the following window and changes to Stop Logging when you return to the main program. Select file name and location where the file is to be stored. This feature stores the telegrams in two files, one with a *.pbn extension and one with a *.pbn.txt extension. The Hex encoded text file can be read by a text editor, opened as an input to this program, or translated to a text file that can be imported into a spreadsheet program for analysis. To stop the logging process, click on the Stop Logging button and the log file will be saved.



Save in: My Documents

File name: Pausch1

Save as type: Pausch Binary (*.pbn)

Save As
My eBooks
My Music
My Pictures
44.pbn
911.pbn
p4-0006r.pbn
P4-0047L.pbn
Pausch1.pbn
Pausch1_23.pbn
Pausch1_23a.pbn
Pausch1_24.pbn
Pausch147.pbn
Pausch2.pbn
Pausch3.pbn
Pausch4.pbn
Pausch5.pbn
Pausch6.pbn
Save
Cancel

The START LOGGING Button Lets You Save Data to a File

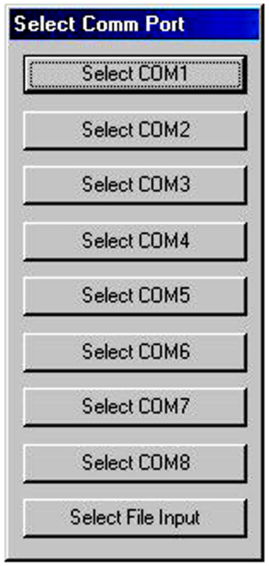
The following is an example of what the log file looks like when it is opened by a text editor. Log files always have*.pbn.txt extensions.

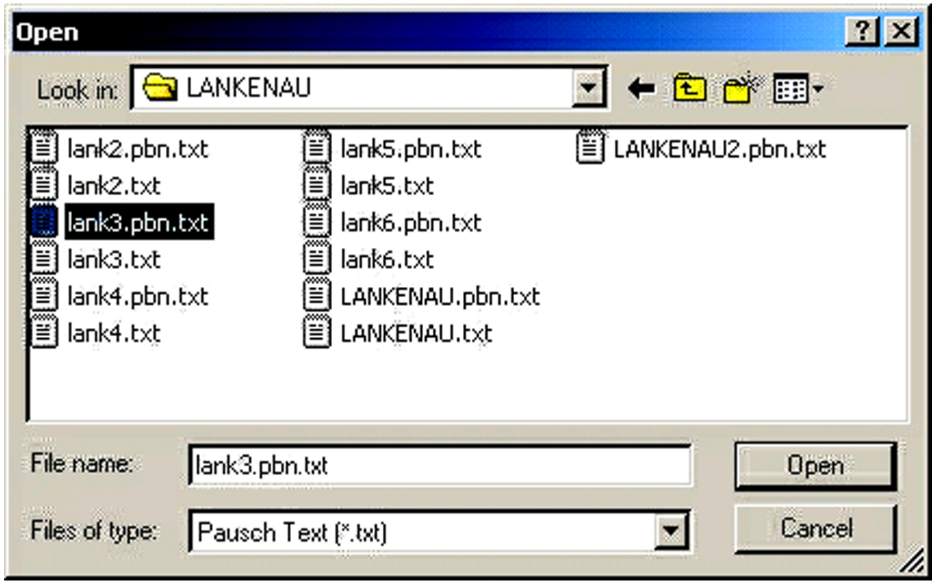
```
03 01 00 00 12 FF 01 4E 00 02 FF    36.31                    30.05
03 00 A0 00 00 00 00 00 00 00 FF    36.53                     0.22
03 00 60 00 00 FF 00 00 00 00 00    36.58                     0.05
03 00 20 02 00 FF 00 00 00 00 00    36.64                     0.06
03 01 00 00 12 FF 01 4E 00 02 FF    36.69                     0.05
03 00 07 02 01 03 C1 00 4A 00 FF    43.67                     6.98
03 00 A0 00 00 00 00 00 40 00 FF    43.72                     0.05
03 00 07 02 08 03 C1 00 4A 00 FF    44.10                     0.38
03 00 07 02 13 03 C1 00 4A 00 FF    44.60                     0.50
03 00 07 02 1E 03 C1 00 4A 00 FF    45.09                     0.49
```

```
03 00 07 02 28 03 C1 00 4A 00 FF    45.64                         0.55
03 00 07 02 38 03 C1 00 4A 00 FF    46.14                         0.50
03 00 07 02 4A 03 C1 00 4A 00 FF    46.63                         0.49
03 00 07 02 5D 03 C1 00 4A 00 FF    47.13                         0.47
```

Input Select and Replaying a Log File

Press the Input Select button at the lower left corner of the window. The Select Comm Port window comes up. Select any of the com ports on your computer or the bottom one as a file input. If one of the com ports is selected, the software will be looking at that com port for the data. If Select File Input is selected, the “Open” window comes up.


Select Comm Port
Select COM1
Select COM2
Select COM3
Select COM4
Select COM5
Select COM6
Select COM7
Select COM8
Select File Input


Open
Look in:
LANKENAU
lank2.pbn.txt
lank2.txt
lank3.pbn.txt
lank3.txt
lank4.pbn.txt
lank4.txt
lank5.pbn.txt
lank5.txt
lank6.pbn.txt
lank6.txt
LANKENAU.pbn.txt
LANKENAU.txt
LANKENAU2.pbn.txt
Open
Cancel

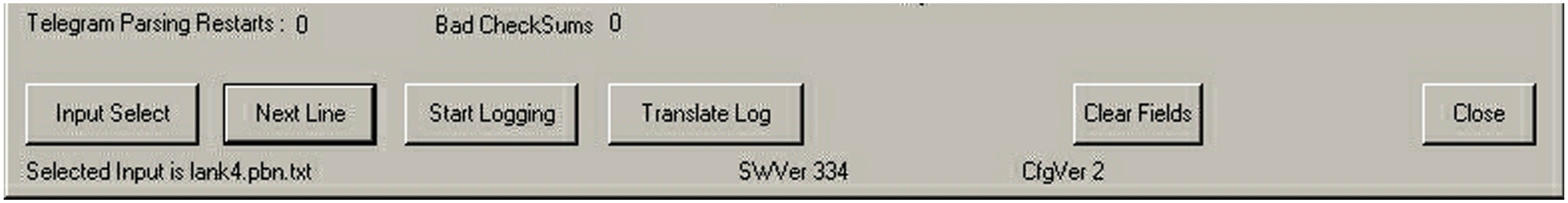
File name: lank3.pbn.txt

Files of type: Pausch Text (*.txt)

Select a Comm Port Input

Select a File Input (*.Pbn.Txt)

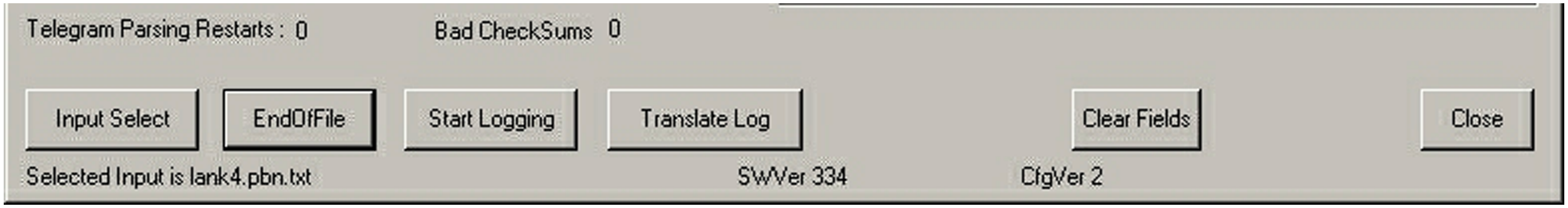
Select the file to be input into Pausch tool software. Choose a file with both the .pbn and .txt extensions as in the picture above. This will put a new button—Next Line— at the bottom of the software window as in the picture below. Each time the Next Line button is clicked it feeds a new telegram line into the translator with the same time stamp of the line when logged. This will continue until the end of the file is reached.


Input Select
Next Line
Start Logging
Translate Log
Clear Fields
Close

Telegram Parsing Restarts : 0
Bad CheckSums 0
Selected Input is lank4.pbn.txt
SWVer 334
CfgVer 2

The NEXT LINE Button Appears

The Next Line button changes to the End Of File button:


Input Select
EndOfFile
Start Logging
Translate Log
Clear Fields
Close

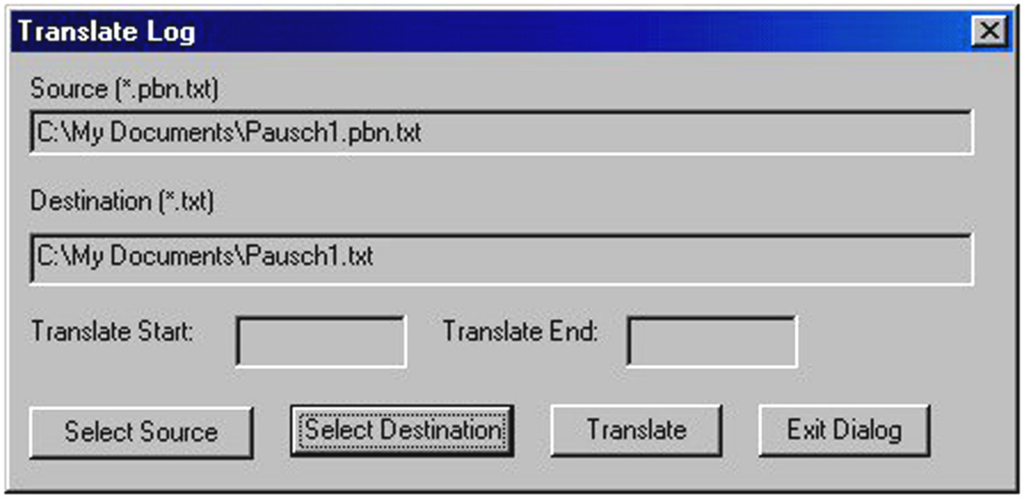
Telegram Parsing Restarts : 0
Bad CheckSums 0
Selected Input is lank4.pbn.txt
SWVer 334
CfgVer 2

The NEXT LINE Button Changes To END OF FILE At The Last Line Of The Logged Data

At the end of the file, you can select a new input, click on the Input Select button and select the desired input. In order to replay the same file just played back, select another file or com port, then the desired file.

Translate a Log File

To translate a log file into text, click on the Translate Log button. This will bring up the Translate Log dialog box (see next picture).



Source (*.pbn.txt)
C:\My Documents\Pausch1.pbn.txt

Destination (*.txt)
C:\My Documents\Pausch1.txt

Translate Start:

Translate End:

Translate Log Dialog Box

1. Click on the Select Source button and select the file to be translated.
2. Click on the Select Destination button and select the file name and destination.
3. Click on the Translate button and the file will be translated from hexadecimal numbers to text sentences.

4. Click on the Exit Dialog button when done translating files. Multiple files can be translated in one session. To do this, select a new source and destination file for each one then translate.

The following is an example of a log file before it is translated.

```
03 00 07 02 48 03 C1 00 4A 00 FF    250.73                      0.49
03 00 07 02 36 03 C1 00 4A 00 FF    251.22                      0.49
03 00 07 02 23 03 C1 00 4A 00 FF    251.72                      0.50
03 00 07 02 11 03 C1 00 4A 00 FF    252.27                      0.55
03 00 80 00 F0 FF 00 00 00 00 00    254.57                      2.30
03 00 20 02 00 FF 00 00 00 00 00    559.14                    304.57
03 01 00 00 12 FF 01 4E 00 02 FF    560.18                      1.04
03 00 80 00 33 FF 00 00 00 00 00    560.18                      0.00
03 00 A0 00 00 00 00 00 00 00 FF    560.40                      0.22
03 00 60 00 00 FF 00 00 00 00 00    560.45                      0.05
03 00 20 02 00 FF 00 00 00 00 00    560.51                      0.06
03 01 00 00 12 FF 01 4E 00 02 FF    560.56                      0.05
03 01 00 00 12 FF 01 4E 00 02 FF    590.17                     29.61
03 00 A0 00 00 00 00 00 00 00 FF    590.39                      0.22
03 00 60 00 00 FF 00 00 00 00 00    590.39                      0.00
03 00 20 02 00 FF 00 00 00 00 00    590.50                      0.11
03 01 00 00 12 FF 01 4E 00 02 FF    590.55                      0.05
03 01 00 00 12 FF 01 4E 00 02 FF    620.60                     30.05
03 00 A0 00 00 00 00 00 00 00 FF    620.82                      0.22
03 00 60 00 00 FF 00 00 00 00 00    620.87                      0.05
03 00 20 02 00 FF 00 00 00 00 00    620.93                      0.06
03 01 00 00 12 FF 01 4E 00 02 FF    620.98                      0.05
03 00 09 02 0C 03 76 00 A0 03 FF    622.25                      1.27
03 00 09 02 0C 03 76 00 A0 03 FF    622.36                      0.11
03 00 09 02 0C 03 76 00 A0 00 FF    622.80                      0.44
03 00 09 02 1A 03 76 00 A0 00 FF    623.29                      0.49
03 00 09 02 27 03 76 00 A0 00 FF    623.78                      0.49
03 00 09 02 36 03 76 00 A0 00 FF    624.28                      0.50
03 00 09 02 4C 03 76 00 A0 00 FF    624.77                      0.49
03 00 09 02 65 03 76 00 A0 00 FF    625.32                      0.55
03 00 09 02 7D 03 76 00 A0 00 FF    625.82                      0.50
03 00 09 02 96 03 76 00 A0 00 FF    626.31                      0.49
03 00 09 02 AF 03 76 00 A0 00 FF    626.80                      0.49
```

The following is the preceding log file after it has been translated to a text file. A program like Microsoft Excel is best to view the translated file, but you can also use a text editor like Notepad or a word processor like Word.

```
 Time    C1                              C2                 Text      Min     Current               Max             Status
250.73   Potentiometer      TblTp Long.(07h)                NA        74        584                 961             Normal
251.22   Potentiometer      TblTp Long.(07h)                NA        74        566                 961             Normal
251.72   Potentiometer      TblTp Long.(07h)                NA        74        547                 961             Normal
252.27   Potentiometer      TblTp Long.(07h)                NA        74        529                 961             Normal
254.57   Status             Load Pos. (80h)             Film Load position not reached
559.14   Status             Film Format (20h)           Film format 35 x 43
560.18   Configuration      Table Config (100h)                   Table ready - configured left, with film
560.18   NA                 NA                          SWVer 334 CfgVer 2
560.18   Status             Load Pos. (80h)                        X-ray arm in x-ray position (obsolete)
 560.4   SpecialBits        Status                         8/6 C
 560.4   SpecialBits        Error                          6/4 C
560.45   Status             Magnification (60h)           Normal
560.51   Status             Film Format (20h)           Film format 35 x 43
560.56   Configuration      Table Config (100h)                   Table ready - configured left, with film
560.56   NA                 NA                          SWVer 334 CfgVer 2
590.17   Configuration      Table Config (100h)                   Table ready - configured left, with film
590.17   NA                 NA                          SWVer 334 CfgVer 2
590.39   SpecialBits        NA                                     No Changes in Status/Warnings or Errors
590.39   Status             Magnification (60h)           Normal
 590.5   Status             Film Format (20h)           Film format 35 x 43
590.55   Configuration      Table Config (100h)                   Table ready - configured left, with film
590.55   NA                 NA                          SWVer 334 CfgVer 2
 620.6   Configuration      Table Config (100h)                   Table ready - configured left, with film
 620.6   NA                 NA                          SWVer 334 CfgVer 2
620.82   SpecialBits        NA                                     No Changes in Status/Warnings or Errors
620.87   Status             Magnification (60h)           Normal
620.93   Status             Film Format (20h)                                Film format 35 x 43
620.98   Configuration      Table Config (100h)                   Table ready - configured left, with film
620.98   NA                 NA                                               SWVer 334 CfgVer 2
```

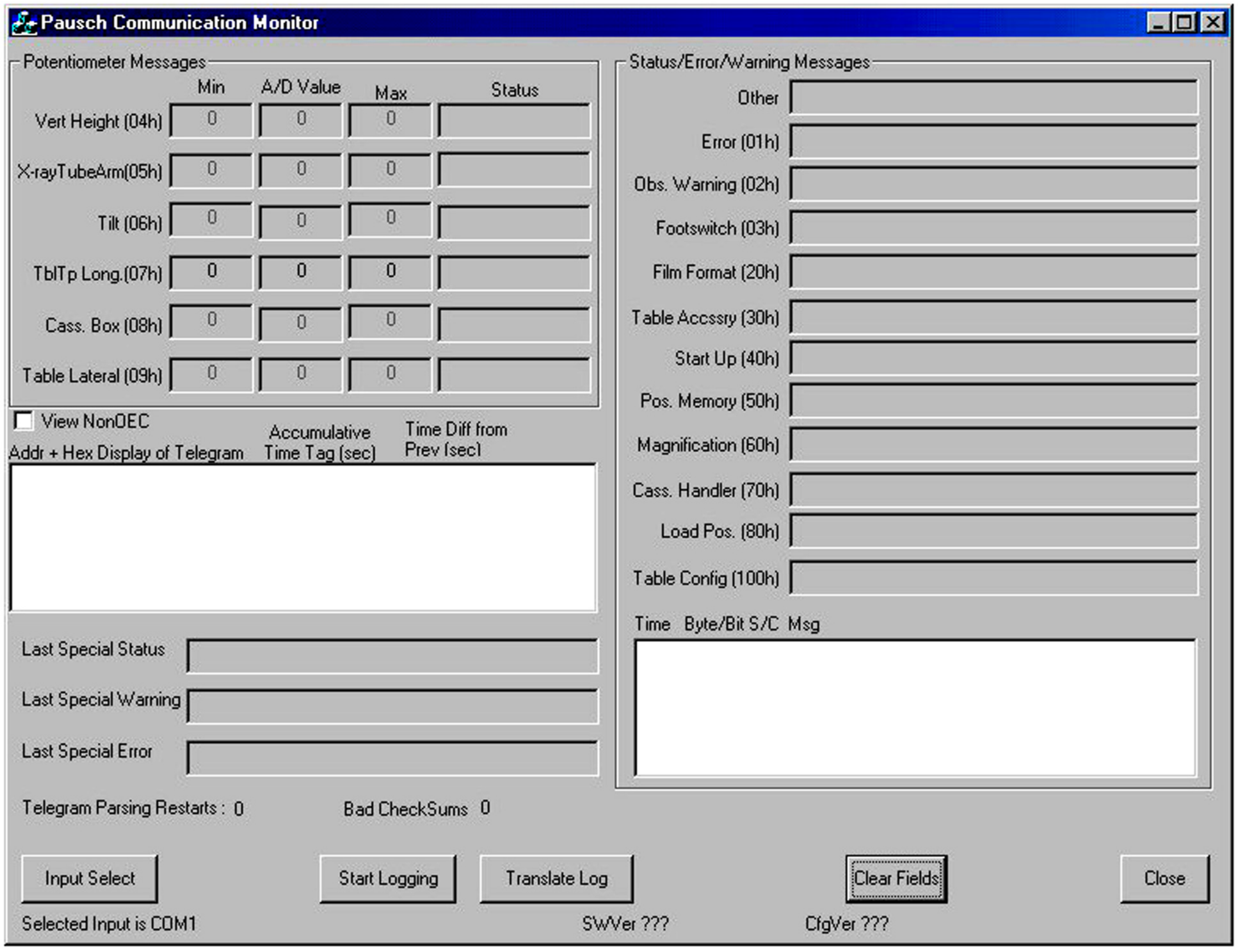
```
 622.25   Potentiometer    Table Lateral (09h)          NA       160       524                 886            At Center
 622.36   Potentiometer    Table Lateral (09h)          NA       160       524                 886            At Center
  622.8   Potentiometer    Table Lateral (09h)          NA       160       524                 886            Normal
 623.29   Potentiometer    Table Lateral (09h)          NA       160       538                 886            Normal
 623.78   Potentiometer    Table Lateral (09h)          NA       160       551                 886            Normal
 624.28   Potentiometer    Table Lateral (09h)          NA       160       566                 886            Normal
 624.77   Potentiometer    Table Lateral (09h)          NA       160       588                 886            Normal
 625.32   Potentiometer    Table Lateral (09h)          NA       160       613                 886            Normal
 625.82   Potentiometer    Table Lateral (09h)          NA       160       637                 886            Normal
 626.31   Potentiometer    Table Lateral (09h)          NA       160       662                 886            Normal
  626.8   Potentiometer    Table Lateral (09h)          NA       160       687                 886            Normal
```

Clear Fields

To clear all the fields in this program click on the Clear Fields button and all the data will be cleared as in the picture below.

Close the Program

Closing this program can be done two ways. Click either the Close button or the X box at the upper right corner of the screen.


Pausch Communication Monitor
Potentiometer Messages
☐ View NonOEC
Addr + Hex Display of Telegram
Accumulative Time Tag (sec)
Time Diff from Prev (sec)
Last Special Status
Last Special Warning
Last Special Error
Status/Error/Warning Messages
Other
Error (01h)
Obs. Warning (02h)
Footswitch (03h)
Film Format (20h)
Table Accssry (30h)
Start Up (40h)
Pos. Memory (50h)
Magnification (60h)
Cass. Handler (70h)
Load Pos. (80h)
Table Config (100h)
Time Byte/Bit S/C Msg
Input Select
Start Logging
Translate Log
Clear Fields
Close

	Min	A/D Value	Max	Status
Vert Height (04h)	0	0	0	
X-rayTubeArm(05h)	0	0	0	
Tilt (06h)	0	0	0	
TblTp Long.(07h)	0	0	0	
Cass. Box (08h)	0	0	0	
Table Lateral (09h)	0	0	0	

Telegram Parsing Restarts : 0

Bad CheckSums 0

Selected Input is COM1

SWVer ???

CfgVer ???

All Data Cleared from Screen